AGRICULTURAL COLLEGE SERIES

H. H. LeDREW, B.S.A., Editor

THE DAIRY FARM

By

A. LEITCH, B.S.A.

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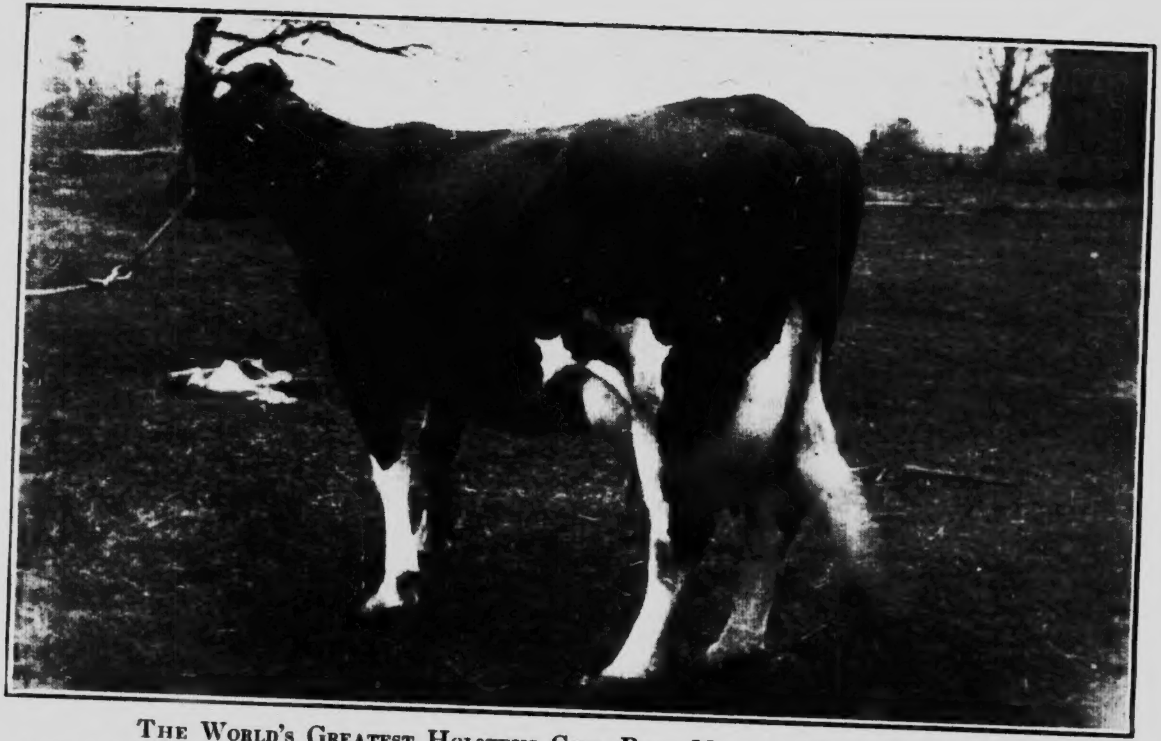

The World's Greatest Holstein Cow, Rolo Mercena De Kol, 30313.

World's champion for butter for 7 and 30 days. 7 days, butter 51.93 lbs; milk 738.9 lbs; 30 days, butter 201.17 lbs; milk 2,930.6 lbs; 60 days, butter 432.58 lbs; milk 5,699.7 lbs. Owned by Mr. N. E. Hanmer, Norwich, Ont., Canada. Photo by the Holstein-Friesian World.

THE DAIRY FARM

DAIRY CATTLE METHODS, AND DAIRY FARM MANAGEMENT

By

A. LEITCH, B.S.A.

ILLUSTRATED WITH
PHOTOGRAPHS AND PLANS

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PREFACE

This book is an endeavour to present in printed form the experience of the author gained in twelve years devoted to the management of large commercial dairy farms, supplemented by information gleaned from the work and publications of students and investigators of dairy cattle husbandry, in Canada and the United States. In addition, the last six chapters of this book endeavor to deal as simply as possible with some of the outstanding features of dairy farm economics and management brought recently to light by investigations of dairy farm businesses conducted during the past three years by the Department of Farm Management of the Ontario Agricultural College, with which it has been the author's privilege to be connected.

Some of the material in the first half of the book was prepared by the author and published by the Ontario Department of Agriculture in the form of a bulletin on Dairy Cattle. Some sections in the last half of the book have been published by the author in the form of pamphlets, bulletins, etc., setting out the progress of the Department in investigation of farm business.

It is hoped that this book will be found of some use by the student of dairy cattle methods and of dairy farm economy, and that the dairy farmer will find something of value therein, if only to open up for thought and discussion some avenues in the field of dairy farm management that have as yet been untrod by Canadian writers and teachers.

A. LEITCH

Ontario Agricultural College,
Guelph, Canada.
July 1920.

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THE DAIRY FARM

CHAPTER I

INTRODUCTION

THE COW—THE ECONOMY OF DAIRY FARMING

THE stages in the advancement of the dairy cow are milestones in the progress of civilization. Milk, with its products, though long recognized as prominent in importance as a human food, reaches the acme in its production both in volume and economy amongst those peoples who have advanced furthest along the road to mental and moral perfection.

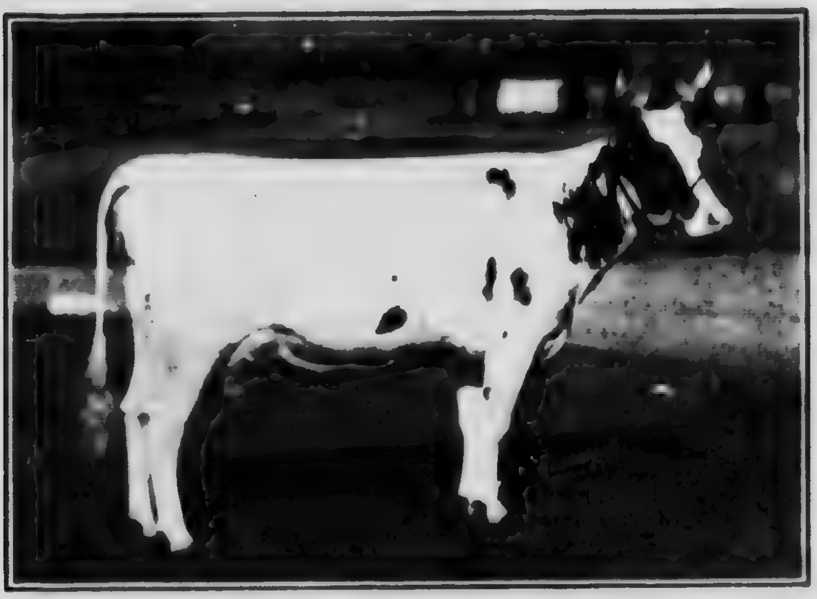
Of all our farm animals, the dairy cow is the most economical producer of human food. No other animal can turn into so much money the great range of animal foods, roughage and concentrates grown on the average farm. The product of no other farm animal, when sold off the farm, removes so little of the fertilizing constituents or plant food from the soil. She is the only farm animal that every day yields a marketable product within twenty-four hours from the time her food is fed. It has been proven by careful experiments that a cow yielding thirty pounds of average milk per day will in one week produce 26¼ pounds of dry matter, all of which is edible and immediately available for human consumption. In the same time a fattening steer gaining two pounds per day, on approximately the same feed, will produce only 10½ pounds of edible dry matter. It has also been shown that from 100 pounds of digestible matter in the food, the dairy cow produces 18 pounds of digestible solids suitable for man; the pig, 15.8 pounds; poultry, as eggs, 5.1 pounds; as meat, 4.2 pounds; lambs, 3.2 pounds; steer, 2.8 pounds; and sheep, 2.6 pounds, clearly demonstrating that the dairy cow easily leads all other farm animals in economy of feeding operations.

With this great advantage in economy of production, it is quite easy to discern why the dairy cow tends to supplant the meat-bearing animals in regions where land is high priced and population dense. She gives the greatest financial returns from the feeds grown on the farm, and therefore enables the owner to get the necessary added returns from his high-priced land. Still easier is it to see why the dairy cow has supplanted the meat-bearing animals where land has become impoverished. Here she enables the farmer to get the greatest financial returns from what little his land does produce and at the same time returns to the soil practically all the plant food taken out by the feed she eats.

One of the favorable economic features of the dairy business is the regularity and dependability of the returns. This appeals particularly to the small farmer of limited means to whom security of returns is of more moment than the volume of profits. Moreover a development of dairying on a small farm affords an opportunity of increasing the volume of business on a limited area, with the well recognized business results of larger profits from larger business on the same plant.

In spite of her superiority over other animals in the use she makes of her food, there are some factors in the dairy industry that restrain or limit the spread or increase of dairying to the greater exclusion of other lines of live stock productio First in importance is the greater amount of lab entailed. Roughly speaking, it takes seventy-five hours to milk a cow for an ordinary lactation period. This amount of labor has no counterpart in other branches of farming. It is extra work above feeding and other care. It must be done twice a day every day she milks, no matter what conditions of weather, what rush of work, or what social duties prevail. Therefore, as a business, dairying does not appeal to the farmer who can make a reasonable living or income otherwise. Again, there is an enormous bulk of dairy products derived from cows that are not strictly dairy cows. This butter and milk comes from a large number of small herds at the time of the year when cows are fed the cheapest, in spring and summer. These herds are cheaply wintered on the roughest and most unmarketable foods grown, and more important, are milked with the least expensive labor, the farmer's own family, at those times of the year when labor is at its greatest demand. These herds are the beef herds or general farming herds of the country, and although the contribution of each to the butter market is small, the sum total is a very large amount of butter that has an appreciable effect in keeping down the market price for butter fat, which is in the final analysis, the controlling factor in the price of all dairy products.

In the course of history of a new country, such as ours, the growth of dairying is obviously slow. But steady growth is inevitable as according to population increase, lands become more valuable through proximity to great markets or become impoverished through bad cropping systems, and the dairy cow introduces herself as the great stabilizer of lands and peoples, the one animal without whose help the human race could not exist.



A MAGNIFICENT TYPE OF AYRSHIRE FEMALE, PANSY'S DAUGHTER OF SOUTH FARM,

A noted prize winner at the largest Dairy shows.

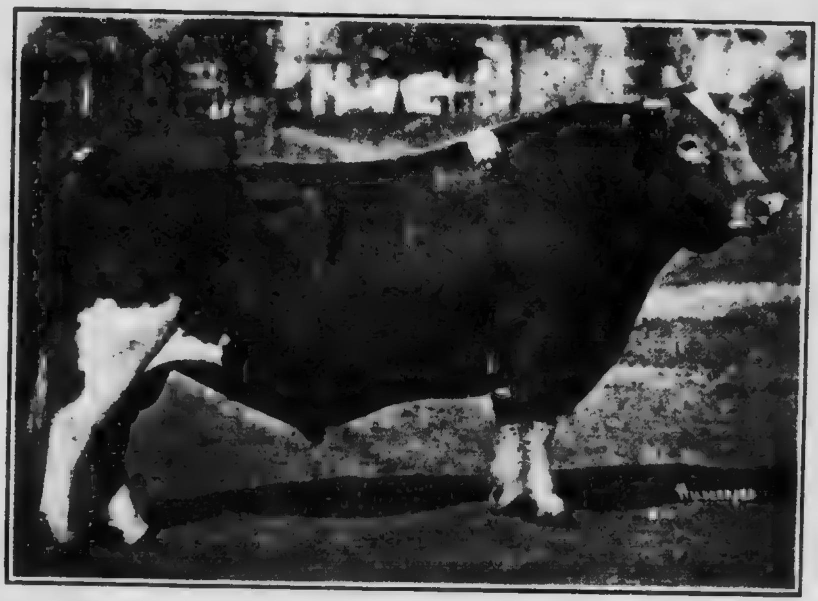
HOLSTEIN COW, CALAMITY SNOW MECHTHILDE 2ND No. 26707.

Canadian champion in Record of Performance at 3y—Milk, 23,274 lbs., Butter, 1,053.75 lbs. Record at mature age—Milk, 25,598 lbs., Butter 1,108.75 lbs. Owned by Walburn Rivers, Ingersoll, Ont.

Holstein Bull, Oak De Kol Ollie Homestead.
Grand Champion at National Dairy Show 1916 and 1917.

Jersey Bull, Sultanne's Raleigh.
A grand champion at large Canadian shows for many years.
Owned by B. H. Bull & Sons, Brampton, Ont.

Some Good Jersey Types.
Owned by Hood Farm, Lowell, Mass.



Guernsey Bull, Imp. Masher's Galore 8572.
One of the famous bulls of the Guernsey breed.

THE WORLD'S GREATEST HOLSTEIN COW, ROLO MERCENA DE KOL, 30313.
World's champion for butter for 7 and 30 days. 7 days, butter 51.93 lbs; milk 738.9 lbs; 30 days, butter 201.17 lbs; milk 2,930.6 lbs; 60 days, butter 432.58 lbs; milk 5,639.7 lbs. Owned by Mr. N. E. Hanmer, Norwich, Ont., Canada. Photo by the Holstein-Friesian World.

CHAPTER II

THE DAIRY BREEDS

ORIGIN, HISTORY AND CHARACTERISTICS OF THE PROMINENT BREEDS OF DAIRY CATTLE

AYRSHIRES

THE Ayrshire breed of cattle originated in the County of Ayr, which is in southwestern Scotland. The early history of Ayrshires reveals the fact that they were developed under adverse conditions. Much of this district is rough and hilly, feed was scarce, pastures scant, and little care was given to live stock. These conditions resulted in the development of a hardy, thrifty type of cattle, as only the more vigorous animals were able to exist. The native stock was improved by crossing with other breeds, and by the selection of the best of these. It is claimed that Dutch cattle were first used with a view of increasing the milk flow, later Shorthorn and Alderney were infused which improved the breed in respect to smoothness of form and quality of milk.

The color and general characteristics of this breed are quite distinct. Red and white, or brown and white, is the prevailing color; the two colors are distinct and do not blend to form a roan. The very striking feature of the Ayrshire is the rather long large horns which as a rule curve outwards and upwards, and in most cases, slightly backwards.

The size of the Ayrshire is medium, ranking between the Jersey and Holstein-Friesian. Mature cows will weigh about 1,000 pounds and upwards, and bulls approximately 1,500 pounds.

Cows of this breed have produced very good yields of milk, but as a breed they are noted for a good uniform production of fairly good quality of milk, rather than for remarkable records. Coupled with this, they are economical producers, responding well to good feeding and management, and even under conditions that are not the most favorable, they will make a reasonably good showing.

Ayrshires were brought into Canada, early in the 19th century by the Scotch settlers. Since that time numerous importations have been made, and we find the Ayrshire distributed fairly well over the Dominion, more particularly in Eastern Ontario and Quebec.

HOLSTEIN-FRIESIAN

This breed is said to be one of the oldest in existence. Originating in North Holland and Friesland, they can be traced back over two thousand years, continuously occupying this territory and always famous for dairy purposes. Very little, if any, foreign blood was introduced in the development of this breed, improvement being brought about by good care in feeding and management and careful selection.

These cattle have been known both in Europe and America by several different names,—“Holland's Cattle”, “Dutch Cattle”, “Holsteins”, “Dutch Friesians”, “Netherland Cattle”, and “Holstein-Friesian”. These are all the same breed. The names “Dutch”, “Holland”, and “Friesland” refer to cattle from Holland, and “Holstein”, is the name given to cattle of practically the same breeding and type from the Province of Holstein in Germany. Considerable confusion was caused by the diversity of names, during the early importation into America, and to overcome this the breeders and importers decided upon the name “Holstein-Friesian”.

Characteristics—In size the Holstein-Friesians are the largest of the dairy breeds. Full grown cows will weigh from 1,000 pounds to 1,400 pounds. The bulls at maturity are very large and heavy, often attaining a weight of 2,500 pounds.

The accepted color of this breed is black and white, in any proportion. These two colors are seldom mixed, the outlines of the marking being usually fairly distinct.

The introduction of the Holstein-Friesian into America dates back to late in the seventeenth century. These were brought over by the early Dutch settlers into New York. About one hundred years later more importations were made from Holland. Since then they have increased rapidly by importations and by breeding, and are now pretty well distributed over the United States and **Canada.**

Having been bred for so many years especially for dairy purposes, it is only natural to expect large development in all those parts that relate to milk production. Speaking generally, they are noted for their large flow of milk, not a few very high milk records having been made by members of this breed. During the past few years more attention has been given to weighing the fat content of the milk, with the result that Holstein milk from the standpoint of quality is now looked upon more favorably than it was some time ago.

JERSEYS

The native home of the Jersey is on the Island of Jersey being one of the Channel Islands owned by Great Britain. The origin of this breed is more or less speculative. It is believed, however, that they are descended from the cattle of Normandy and Brittany in France. The cattle from these countries were supposed to have some characteristics in common with the Jerseys as we know them to-day, this is particularly true of the fawn and dark color.

The Island of Jersey, being small in area, containing less than 30,000 acres, lends itself to keeping the herds pure, and the Islanders have taken advantage of this. As early as 1763 laws were enacted prohibiting the importation of any other breed of cattle except for slaughtering purposes. With a view of further improving and protecting the breed, the Royal Agricultural Society was organized early in the nineteenth century and by means of careful selection the breed rapidly improved in quality and uniformity of type.

The Jerseys have been referred to as the aristocrats among dairy cattle. The foundation for this may probably have its origin in the fact that we have records of cattle resembling Jerseys being brought from France and the Channel Islands into England to decorate and add dignity to the estates and parks of the nobility. The establishing of these herds in England has had much to do with the development and improvement of the Jerseys.

Jerseys were introduced into the United States, notably Connecticut, New York and Pennsylvania, about the middle of the nineteenth century, and into Canada a few years later. Since that time numerous importations have been made, and these form the basis for the herds now in existence in Canada and in the United States.

Characteristics—The color of the Jersey is variable, running from a light fawn to a brown, gray or red fawn. In some individuals the body may be nearly black. However, the fawn color over the entire body is preferred. In recent years, however, probably less importance has been attached to the color of the Jerseys than formerly.

The Jersey is essentially a dairy animal, and in conformation represents the lean, muscular, appearance characteristic of this type. Withal there is a blending of all parts which gives the breed a general appearance of smoothness. In size they are the smallest of the dairy breeds, the mature cows ranging from 700 pounds upward to 1,000 pounds. The mature bull should weigh at least 1,300 pounds. The general tendency with this breed is to reach maturity at rather an earlier age than some of the other dairy breeds.

The Jerseys have long been recognized as producers of milk rich in butter fat, the fat globules are comparatively large and the cream easily separated. Thus this breed has been, and will continue to be, well adapted for those dairymen wishing to produce butter of good quality. Although there are individuals of this breed that have ranked high for quantity of milk, at the same time they are not characterized by large flow, quality of milk rather than quantity being the merit of this particular breed.

GUERNSEY CATTLE

The native home of this excellent breed of dairy cattle is in the same group of Islands as the native home of the Jerseys, the island having the name of Guernsey. The island of Guernsey, according to reliable information, is of about 15,000 acres in area and supports about 45,000 people who are practically dependent upon agriculture for a living. Because of this fact they have found it necessary to develop their cattle to a very high degree in order that they produce the maximum amount of milk and butter from the minimum amount of feed.

The origin of the Guernsey is quite obscure, but it is surmised that they originated from the same French ancestry as the Jersey, but different systems of breeding by the Jerseymen and Guernseymen, evolved two different strains which eventually developed into distinct breeds. The Jerseyman, by skilled and persistent breeding developed a cow that took the eye of the English farmer while the Guernseyman maintained that his breed was a farmer's cow and worked along those lines, thereby developing a dairy cow of unusual dairy propensities and dairy temperament.

The Guernsey cattle have been bred pure a great many years and this was accomplished by passing stringent laws which were effectual in breeding up a pure breed of cattle. As early as 1789 there were measures taken to keep the breed pure and in 1819 laws were enacted which prohibited the importation of cattle to the Island except for immediate slaughter. From these actions on the part of the Islanders it will be quite easily seen that it would be possible to build up an extremely pure breed.

This breed had an early introduction into America, having first been imported to Pennsylvania about 1818, but unfortunately no authentic record was kept of these cattle. Again about 1830 some of these cattle were imported and after that at regular intervals up until the present time when there are good substantial importations being made.

The Guernsey cattle are essentially a dairy breed of cattle. In general appearance they are a little larger than the Jerseys, are a little coarser in style, show a little more constitution, and are a little different shade of fawn color. The color is either a yellowish, brownish or reddish fawn with white markings or white on the under parts of the body and limbs. A rich yellow skin secretion is most characteristic of the Guernsey and much emphasis is laid upon it in the the scale of points for the breed. The size of the Guernsey that is most acceptable to Americans is about 1,500 pounds for mature bulls and 1,050 pounds for cows of mature age.

The Guernsey as a dairy cattle ranks very high in America The cows are very persistent in their milk and because of this they make very creditable records. Several records of over 12,000 pounds milk in 365 days are due to the breed. It is reported that one herd of 104 animals of all ages made an average record of 5,317 pounds milk. As a butter producer the Guernesy deserves special distinction. In numerous tests at experiment stations, on farms and under public competition this breed has attained high honors. The Guernsey milk has a high natural color which makes the fat naturally valuable in butter making.

French Canadians

This breed is found almost entirely in the Province of Quebec, though occasional herds are found in the Maritime Provinces, in Northern Ontario and some of the Northern New England States. These cattle are descended from importations made by the early French settlers of Canada who brought with them cattle from the Provinces of Brittany and Normandy in France. This breed is, therefore, closely allied to the Jersey and Guernsey breeds, being descended from cattle of the same racial origin. Through four centuries of breeding in a rather severe climate this breed has developed wonderful hardihood, astonishing productiveness, considering their size, and ability to rustle a living and give good returns from the scantiest and roughest of pastures and feeds.

In color they are black, or a very dark fawn with a fawn or yellowish strip down the back and around the muzzle. In size they average slightly smaller than the Jersey and in general shape they resemble very closely the same breed. While they have not reached the same degree of productiveness in milk as the Jersey, the quality of the product is very similar in butter fat content. Many individual cows have however made exceptionally large milk and fat records.

The breeders of these cattle have a strong and flourishing association and have had a herd book in existence for the past thirty-five years.

CHAPTER III

MINOR DAIRY BREEDS

BROWN SWISS, DUTCH BELTED, POLLED JERSEYS, DEXTER KERRIES.

THE Brown Swiss breed of dairy cattle has of late years made some strides in Canada. This breed, originating in the northeastern part of Switzerland, is one of the oldest in existence. Although quite large importations have been made to the United States, to the extent that there this breed ranks as an important dairy breed, this race of cattle has found its greatest distribution in Central European countries. Developed on the mountainous pastures of the Lower and Middle Alps with rather close confinement in winter, this breed has become a strong, rugged one with large bone and a tendency to beefiness not usually associated with strictly dairy breeds. One of the notable characteristics is exceptional breeding powers retained to an unusual age. In color they are mouse brown or some similar shade of gray, with nose, tongue and switch invariably black. Solid color without white patches is most desirable. In size these cattle are somewhat larger than the Ayrshire. The cows give on the average slightly less milk than the average Ayrshire with a somewhat smaller butter fat content. In Europe the breed is looked upon as having profitable beef-making qualities.

Dutch Belted

Few of these strikingly marked cattle are found in Canada. They are chiefly characterized by a broad white belt entirely surrounding the middle of the body, while both ends of the animal are jet black. These cattle have high dairy qualities, producing milk of equal quality with the Holstein, though not in such large volume. In size they are similar to the Ayrshire and in conformation they are very like the Holstein.

Polled Jerseys

This breed, practically unknown in Canada, is as its name indicates, a hornless Jersey. It originated in Ohio from naturally polled Jerseys mixed with Jerseys that had been crossed with other hornless breeds. Except for the lack of horns they are similar in every way to the Jersey.

Dexter Kerries or Kerry Cattle

This is a breed of very small cattle native of Ireland. The breed is reputed to have had an admixture of the blood of the Devon Cattle. They are mostly black in color with sometimes white on the udder and underbody. They are very small, the cows seldom exceeding 700 pounds in weight at maturity, but they are sprightly in appearance, vigorous and active, and give a large flow of milk for their size. The milk is somewhat richer in butter fat than the Ayrshire. Very few of these animals are now found in Canada.

Chapter IV

DUAL PURPOSE BREEDS

Shorthorns

THE dual purpose type of cattle is understood to represent one midway between the two special breeds, viz., dairy and beef. What is looked for is an animal that will give a reasonable flow of milk, and, at the same time, in form and general characteristics resemble in a general way what is expected in the [illegible] breeds.

Considerable interest has centred around this particular kind of cattle within the past few years, notwithstanding the fact that there is a tendency on the part of not a few breeders of live stock to produce animals for a special purpose. Conditions prevailing in some parts of the Dominion, coupled with the favorable attitude of some men relative to mixed farming, do not always make it profitable or desirable to keep cattle of the special purpose breeds, and in such cases the dual purpose cow seems to fit in very well.

It is rather difficult to say just where the line should be drawn between dual purpose and special purpose cattle, or in other words, to definitely state what really constitutes a dual purpose animal. Some breeders have emphasized milking qualities and have in their herd individuals that for yield of milk would compare favorably with some strictly dairy-bred animals. Others working with this type have sacrificed something in the way of milk and selected animals that conform pretty well to the beef breeds.

The ideal dual purpose cow in type and general conformation is a combination of the beef and dairy animal, not possessing the blockiness and smoothness of form and lacking the wealth of fleshing of the beef animal, and yet showing these characteristics to a reasonable extent. Something of the angular, wedge-shaped form which is accompanied with milking qualities of the dairy cow must be expected. In development of udder and milk vessels, the dual purpose cow should give evidence of one that will perform fairly well at the pail.

So far as Ontario is concerned the Shorthorn breed represents the only dual purpose animal, very few of the other recognized dual purpose breeds, as, for example, Brown Swiss, Devons and Red Polls, being bred to any extent.

The development of the Dairy Shorthorn, which took place in England, goes back to about the beginning of the nineteenth century. During this time much valuable work was accomplished in improving the Shorthorn breed. One of the prominent men connected with this work was Thomas Bates, who in his breeding operations not only sought to improve the beef qualities of his herd, but also kept careful records of milk yields, and, in this way, developed a strain of cattle that have ever since been recognized as dual purpose animals. Such Shorthorn families as "Duchess", "Waterloo", "Wild Eyes", and "Oxford", still famous for their dairy as well as beef qualities, were founded by Bates. From these noted strains or families have sprung many of the present day dual purpose Shorthorns found in Ontario. In justice to the Shorthorn as a breed, it should be mentioned that even among the Scotch-bred Shorthorns are to be found cows that are no mean performers at the pail.

Dairy Shorthorn herds have also been developed in this country that may have no connection with Bates-bred cattle. Careful breeding, the selection of animals noted for a good yield of milk, together with hand milking of cows, have resulted in building up some very creditable herds of dual purpose cattle in different parts of Canada.

RED POLLS

Little is known of the history of this breed except that it originated in the Counties of Norfolk and Suffolk in England. In those counties they are to-day as popular as the Shorthorn for dual

Guernsey Cow, Langwater Dairy Maid.
Official Record, 16,949 lbs. milk, 813 lbs. of Butter fat in one year.

Shorthorn Cow, Rosa IV, (Imp.)
Grand Champion dual purpose Shorthorn Cow, International Exposition, Chicago, 1919. Milk record, 8,270 lbs. Owned by H. E. Tener, Washingtonville, N.Y.

Four Famous Dairy Shorthorn Cows.

Holstein Cow, Johanna Jemima Posch, No. 24685.

Year's record—Milk 26,415 lbs.; Butter 1,215 lbs. Her dam, Jemima Johanna of Riverside, has year's record of 30,373 lbs. milk and 1,280 lbs. butter. Owned by W. C. Houck, Chippawa, Ont. A good example of inheritance of the milk producing faculty.

Oxford Briar's Flower.
One of the highest priced cows in Jersey history.

Chancellor.
A noted Ayrshire prizewinner in Scotland.

purpose animals. In size they are smaller than the Shorthorn and in color are usually a solid cherry red with occasionally white spots on the udder or the tip of the switch. Most of the cows have fairly good beef conformation especially in the hind quarters while the head, neck and shoulders often approximate the dairy type. The udders are usually uneven in shape and the teats are often unnecessarily large. In milk yields they compare very favorably with the milking Shorthorns. This breed has a fairly wide distribution in the United States and some herds are found in Western Canada.

CHAPTER V

SOME PRINCIPLES OF BREEDING

MODERN science and recent discoveries of certain laws of inheritance have not revolutionized live stock breeding operations of to-day. They have, however, done a great service in freeing breeding of the detrimental influence of certain time-honored beliefs which, in the light of present knowledge, appear as absolute falseness.

Variation is universal. No two are exactly alike. No matter how closely two animals may resemble one another, there always exist certain minute differences. Experience has shown that within a particular breed, or tribe, or strain, we are likely to have exhibited certain variations which seem peculiar to it. Hence, it is essential that in order to gain the greatest success with the breed that is our favorite, we must be well informed as to its history. Then, knowing the history and variations most likely to occur, sound judgment must be used in departing from any of the definite principles of live stock breeding.

It is interesting to note that within comparatively few years a special kind of animal has been produced for practically every utilitarian purpose. This rapid progress has largely come about by breeders keeping always in mind two things—utility, and beauty of form. If the breed we are using is not especially pleasing to our sight, failure is sure to follow. The same thing is true if the breed is lacking in utility. We have no place for the faddist stock breeder.

Observation was the chief asset of early breeders, and from their observations they came to conclusions which, in a measure were correct. They observed that in ordinary breeding operations, like tends to produce like; also that pedigree counts. It was realized that a certain dependence could be placed on an animal's pedigree, but of the value of this working of heredity they were not sure. It was also considered that in a general sense, in-breeding brings uniformity of type but with it a loss of vigor. Likewise, cross-breeding increases vigor, but destroys uniformity in the herd or flock. With these principles well in mind, it is not surprising that much advancement has been made.

Grading:—This implies the mating of a common or relatively unimproved animal with one that is more highly improved, meaning a pure-bred. This is usually accomplished by using a pure-bred male, because in this way one animal's influence is distributed over the entire herd. Grading is the economical method of improving live stock, and consequently is the method in most general use. The reputation of any breed is made more on the grades of that breed than on its pure-bred representatives. It is somewhat surprising to note the percentage of purity in animals with a few top crosses. The progeny of a grade dam from a pure-bred sire is known as half breed or 50 per cent. pure blood. The progeny of a half breed from a pure-bred sire is 3-4 or 75 per cent. pure blood. In this way we arrive at 7-8 or 87.5 per cent. pure blolod: 15-16 or 93.75 per cent. pure blood; 31-32 or 96.87 pure blood: 63-64, or 98.44 pure blood, and so on. Since pure-bred animals are more prepotent than grades, these percentages are no doubt higher than can be shown mathematically.

Crossing:—Means the mating of animals belonging to different breeds, and implies that each is pure-bred. Although this system of breeding has produced some wonderfully good animals, yet it is generally not a wise course to follow. The great danger lies in the fact that there is always a tendency to keep the cross-bred progeny for breeding purposes and seldom, if ever, do they breed as well as their individual merit would lead us to expect.

In-breeding:—Three forms of in-breeding are recognized: Mating the sire with his daughter, the son with his dam, and brother and sister matings. With the first two methods we have some idea what the combination will result in, because we get in the offspring a preponderance of the blood of one individual. In the first-mentioned case, there would be a concentration of three-quarters of the sire's blood lines, and in the second three-quarters of the dam's blood lines. Although brother and sister matings have in some instances given good results, the chances for inferiority are greater than with other methods. It must be borne in mind at all times that we can intensify both the good and the bad by in-breeding. There is ground for the popular objection that in-breeding impairs vigor and high fertility, and we should be careful to note that there are no weaknesses in common, and as much good as possible. The practice of in-breeding should never be adopted by the novice and seldom by the skilful breeder.

Line-breeding:—Line breeding differs from in-breeding merely in degree. The number of ancestors of a line-bred animal in some particular generation, or generations, is fewer than the maximum possible number. It is a mild form of in-breeding, and has been productive of much good when judiciously practiced by experienced breeders. Many of the noted sires of all classes of live stock have been line-bred individuals. Like in-breeding, however, it is not a safe practice for the average breeder.

Vigor and Fertility:—Successful live stock production depends a great deal on a proper degree of constitutional vigor in breeding animals. It is essential to long life and heavy production. Together with lack of vigor, imperfect sexual development is one of the most common defects in animals. Fertility is an unseen quality, and one of the most neglected, yet there is no doubt but that it is a heritable character. It is a relative quality. All, as a rule, produce some offspring. Note the final results as shown in the table below, where the progeny of three cows, each possessing a different degree of fertility, is studied. "A" produces two calves, one of each sex, then becomes infertile. "B" produces four calves, and "C" six calves before losing their powers of reproduction.

Cow	Total Number of Calves	Females			
		1st Generation	2nd Generation	3rd Generation	4th Generation
A	2	1	1	1	1
B	4	2	4	8	16
C	6	3	9	27	81

It is assumed that the female offspring of the original cows were prolific to the same degree as their dams, and the likelihood is that they would be. The progeny of "A" would never build up a herd, and "C's" progeny would soon dominate. It is true that we can hardly over-estimate the value of an old and tried female of our herds. It is history that the reputations of many of our prominent stock breeders have been made largely on the merit of some few exceptional individuals, either male or female, in their herds which possessed a high degree of constitutional vigor and sexual fertility, and were prepotent for these qualities. When our standards are against the highest fertility they are dangerous, if not fatal, to the breed.

CHAPTER VI

NUTRITION

PURPOSES OF FOODS — CONSTITUENTS OF FOODS — FEEDING STANDARDS—FORMULATING RATIONS

Purposes of Foods:—The process of nutrition, or the use which the animal makes of its food, has long been a matter of careful study and experiment among scientists all over the civilized world. In general the animal body requires food for the following purposes:

(1) To maintain the bodily functions of the animal—respiration, blood circulation, digestion, etc., and to restore waste.

(2) To provide body heat, and keep it at normal temperature.

(3) To provide energy for natural movements of the body, and for external work.

(4) To provide, in the immature animal, material for growth in all parts.

(5) To provide in the female, material for the production of milk.

Constituents of Foods: — Investigation has found that there are different elements or substances which are necessary in foods to supply the above requirements in the animal body. These nutrients, as they are called, are all found in varying proportions in the different fodders and grains grown on the farm. They may be divided roughly into four classes:

(1) **Proteids or albumens.**
(2) **Carbohydrates.**
(3) **Fats.**
(4) **Ash or mineral matter.**

These substances make up the dry matter in the feed.

The *proteids* or protein compounds are those containing nitrogen. They enter largely into the formation of lean flesh, or muscle, hide, hair, blood and all the tissues of internal organs, and also into the composition of milk. Protein matter in the food is absolutely essential to life itself in the animal, and no other nutrient in the food can take its place in the formation of the above parts of the animal body. It is known, however, that proteins can take the place of the other nutrients in the work which they do in nutrition. There appears to be a great necessity for protein in stimulating the various functions of the various organs of the body, and as there is a constant breaking down in the tissues of these organs while they are at work, a constant supply of protein is necessary to supply this waste. In the production of milk, protein plays an important part. About 25 per cent. of the total dry matter in milk is protein in its nature, and in addition to supplying this the protein in the food must supply enough to stimulate the milk making machinery of the cow's body, as protein is the cell stimulating nutrient of the food. Protein is found in greatest proportion in such feeds as alfalfa hay, and clover hay, wheat, bran, cotton seed meal, oil cake, and gluten meal.

Carbohydrates are the starches, sugars, fibres and such allied constituents of the food. Their chief function in the body is to supply heat and energy, and they are also the source of much of the fat stored up in the body by fattening animals. They are divided roughly into two classes: nitrogen free extract, such as starch, sugar and gums, and crude fibre, or cellulose, the more indigestible woody part of the plant or grain. The carbohydrates form the largest proportion of all the nutrients in farm-grown cattle foods. Grains, like corn, barley and oats, have from 50 per cent. to 70 per cent. of nitrogen free extract, and 10 to 13 per cent. crude fibre, while rough feeds like hay, straw and corn fodder have 35 to 40 per cent. nitrogen free extract, and 30 to 40 per cent. of the more indigestible crude fibre. In addition to supplying heat and energy to the body, the carbohydrates provide much of the energy for manufacturing milk, also the material necessary for the milk sugar, and also much of the butter fat in the milk.

The Fats in the food play the same part in the process of nutrition as do the carbohydrates. They also are the source of heat and energy in the body and supply to some extent the fat laid on by the animal when gaining in weight. In the case of dairy cows, fat in the food is also the source of part of the fat found in the milk. While fats have the same function in animal nutrition as carbohydrates, it is stated that one pound of fat is equivalent to about two and one-quarter pounds of carbohydrates for the production of heat and energy.

The Ash in the food is the mineral matter that is found in all parts of every plant that is grown. Its use in the animal body is to form bone and to assist in the manufacture of the juices and fluids of the digestive tract of the animal. In the production of milk it also supplies the small percentage of ash found therein.

Water in Feeds:—In addition to the above nutrients all feeding stuffs contain greater or lesser amounts of water, ranging from about 10 per cent. in the case of grains and cured hay, to 90 per cent. in the case of roots and green soiling and pasture crops. This water is of no greater feeding value than that from a well or stream, but the degree in which it is present determines largely the succulence and palatability of the feed, as is seen most easily in roots and green crops of all kinds. In the animal body water is found in every tissue, organ and fluid, and, as is well known, is absolutely essential to life itself, while best results from feeding of any animal depends upon a plentiful supply every day. Water forms about 87 per cent. of the total bulk of milk, and its use is therefore of prime importance in dairy cattle feeding.

FEEDING STANDARDS

To determine the proper amount of each of the different nutrients that should be fed for the profitable production of milk, has been a profound study by many live stock investigators and scientists for the past fifty years. To such a success has this been carried that it is now pretty well determined just what amounts of the various nutrients are necessary for the animal under nearly all conditions. Moreover, the analysis of rations fed by successful feeders, who feed from experience and judgment only, show that their rations correspond very closely with those advised by investigators, as the result of experimental work. It is true there is considerable variation in the digestive and productive ability of individual cows of the same breed, size and bodily condition, so that it is impossible to lay down exact amounts to be fed of the various nutrients in the feeds. It is true also that the exact figures cannot be given of the amounts and digestibility of the various nutrients in all classes of feed stuffs at all times. These vary considerably with weather at harvesting, stage of maturity, and storage conditions of the farm crops and feed stuffs being fed. These factors must be taken into consideration by the feeder himself, who must, in addition, study the likes and capacity of his individual animals if he is to make the best use of the results of feeding investigations.

The investigation work mentioned above has culminated in what are commonly called Feeding Standards. In milk production a feeding standard is a table showing the approximate amount of the various nutrients a cow of 1,000 pounds live weight should receive in her feed, to produce varying amounts of milk daily, to give best results. All kinds of feeding stuffs have been analyzed so that the proportions therein of the various nutrients, protein, carbohydrates, fats, ash, and water are pretty well established. At the same time the animal cannot digest or assimilate all of those various constituents of the different food-stuffs. But it has been established by much experimenting about what percentage of the various nutrients, in each of the different feeds, is digestible. For instance, it is known that oats contain about

11.4 per cent. of protein, or 11.4 pounds protein in 100 pounds of oats. It is also known that about 77 per cent. of this protein, or 8.8 pounds is digestible, so that oats are said to contain 8.8 pounds digestible protein. Red Clover, on the other hand contains 12.3 pounds protein in 100 pounds; just 59 per cent. of this, or 7.1 pounds is digestible. So it is seen that though 100 pounds of oats contain less protein than 100 pounds of red clover hay, the oats have actually more protein that is available because it is more digestible. In contemplating feeding standards it is necessary, therefore, to take into account only the digestible portion of the nutrients of the different feeds. When applying feeding standards to milk production, in addition to the nutrients mentioned, the total amount of dry matter in the ration is the important factor. All ruminant animals (those that chew the cud) require a bulky ration in order to keep their large digestive organs properly distended. The dry matter in a ration for dairy cows (that part which gives bulk) must always be considered when discussing rations.

Wolff-Lehman Standard:—Feeding standards have been propounded by various live stock investigators in Europe and America. The earliest and most simple and complete standard to be presented is called the "Wolff-Lehman Standard", that portion of which, dealing with milk production, is herewith given:

TABLE I.—Digestible Nutrients Required Daily by Milking Cows Per 1000 Pounds Live Weight.

Dairy Cow Yielding	Dry Matter	Digestible Nutrients			Nutritive Ratio
		Protein	Carbohydrates	Fat	
11 lbs. milk daily	25	1.6	10.0	0.3	1:6.7
16.6 " " "	27	2.0	11.0	0.4	1:6.0
22.0 " " "	29	2.5	13.0	0.5	1:5.7
27.5 " " "	32	3.3	13.0	0.8	1:4.5

Note:—Nutritive ratio is the term used to describe the proportion of digestible protein to digestible carbohydrates and fat in a ration. In making the calculation the fat is multiplied by 2¼ before adding to the carbohydrates.

This Wolff-Lehman feeding standard was for the period of thirty-five years previous to 1907 recognized as the most useful and accurate so far propounded. It was largely used by investigators and practical feeders because of its great simplicity. With tables containing the amount of various digestible nutrients in the feeds at hand, it was a comparatively simple calculation to figure a ration that would be complete, economical and closely conform to the requirements of the animal.

AMERICAN STANDARDS

About ten years ago, however, it was discovered by American investigators that in some respects, and in relation to some classes of live stock, the Wolff-Lehman standards were inaccurate. Some of the recommendations were not properly applicable to conditions on this continent. This was especially true with dairy cattle. It was found that the amounts of dry matter and protein recommended by this standard were too high for economical feeding under American conditions. To determine the true values for such conditions much work has been done by animal nutrition experts on this continent during the last ten years. As a result valuable information along this line of work has been submitted by Professor Haecker of Minnesota, Professors Woll and Humphrey of Wisconsin, Professor Savage of New York, and Professor Eckles of Missouri. The recommendations of these men, which are much in agreement, though stated in different terms, have been drawn upon largely by the writer in submitting herein the following tables showing the approximate requirements for economical rations for cows giving the various quantities and qualities of milk, that are representative of Canadian conditions.

Formulating Rations

In using these tables for computing rations, the following suggestions may be useful:

(1) That a deficiency of two or three pounds of dry matter in a ration where over 20 lbs. is recommended, is not a serious mistake provided the feeder knows that the whole ration is bulky enough to satisfy the craving of the cow for a full stomach. This lack of dry matter in the ration will often occur where a high grade roughage like alfalfa hay or good silage is being fed, in which case the proper amount of digestible protein or carbo-

WOLFF-LEHMAN STANDARDS

MODIFIED FOR CANADIAN CONDITIONS

TABLE II.

	Dry Matter	Digestible Protein	Dig. Carbohydrates & fat x 2¼
1000 lb. cow giving 3.5% milk			
	lbs.	lbs.	lbs.
Cow dry	14	.70	7.22
Cow giving 10 lbs. milk	16.5	1.25	9.83
“ “ 15 “ “	19.	1.55	11.13
“ “ 20 “ “	21.5	1.83	12.44
“ “ 25 “ “	24.	2.12	13.75
“ “ 30 “ “	26.	2.39	15.05
“ “ 35 “ “	28.	2.67	16.36
“ “ 40 “ “	30.	2.95	17.66
1000 lb. cow giving 4% milk			
Cow dry	14.	.70	7.23
Cow giving 10 lbs. milk	16.5	1.30	10.09
“ “ 15 “ “	19.	1.60	11.52
“ “ 20 “ “	21.5	1.94	12.91
“ “ 25 “ “	24.	2.28	14.30
“ “ 30 “ “	26.5	2.59	15.72
“ “ 35 “ “	29.	2.91	17.13
“ “ 40 “ “	31.	3.16	18.60
1000 lb. cow giving 4.5% milk			
Cow dry	14.	.70	7.23
Cow giving 10 lbs. milk	17.	1.33	10.36
“ “ 15 “ “	19.5	1.65	11.92
“ “ 20 “ “	22.	2.00	13.45
“ “ 25 “ “	25.	2.36	15 00
“ “ 30 “ “	27.5	2.66	16.55
“ “ 35 “ “	30.	2.99	18.10
For each 100 lb. increase in weight of cow add	1.4	.07	.72

(D)

hydrates is reached before the quantity of dry matter is high enough.

(2) As a basis of computing a trial ration it is well known that a cow should have approximately one pound of dry roughage (hay, straw, etc.) and three pounds silage (or four pounds of silage and roots) for each one hundred pounds of live weight.

(3) To bring the ration up to the standard, the concentrates or grain feed should be fed at the rate of about one pound of grain for each three to five pounds milk produced, depending upon the quality of the milk—the richer the milk, the more grain.

Keeping in mind the above recommendations we will proceed to formulate a ration. We will suppose that the feeder has at hand, at a reasonable price, the following feeds: corn silage, clover hay, oat straw, bran, oats and oil meal. He wishes to feed a standard ration to a 1100 lbs. cow giving 25 lbs. of 4 per cent. milk per day. According to our standard in Table 2 the requirements are:

	Dry Matter	Protein lbs.	Carbohydrates and fat lbs.
For a 1000 lb. cow	24	2.28	14.30
Add for 100 lbs. extra weight of cow	1.4	.07	.72
	25.4	2.35	15.00

Turning to the table of digestible nutrients of the different feeds on Table 5, we find the feeds of this ration to be composed as follows:

TABLE III

In 100 lbs. of	Lbs. Dry Matter	Lbs Digestible Protein	Digestible Carbohydrates and fat x 2¼
Bran	89.0	12.5	48.4
Oats	90.8	9.7	60.7
Oil Meal	90.9	30.2	47.7
Silage	26.3	1.1	16.6
Clover Hay	87.1	7.6	43.4
Oat Straw	88.5	1.0	44.6

Assuming that the following amounts per day of the different feeds appear reasonable, silage 35 pounds, clover hay 7 pounds, oat straw 4 pounds, bran 3 pounds, oats 2 pounds, they are set out in tabular form below as a trial ration to discover how closely their total constituents correspond with the desired standard.

FIRST TRIAL RATION FOR 1100 LBS. COW GIVING 25 LBS. 4 PER CENT. MILK PER DAY

Feed		Dry Matter lbs.	Dig. Protein lbs.	Dig. Fat and Carbohydrates lbs.	Nutritive Ratio
Silage	35 lbs.	9.21	.39	5.81	
Clover Hay	7 lbs.	6.10	.53	3.04	
Oat Straw	4 lbs.	3.54	.04	1.78	
Bran	3 lbs.	2.70	.38	1.45	
Oats	2 lbs.	1.82	.19	1.21	
		23.37	1.53	13.29	1:8.8
Standard		25.40	2.35	15.00	1:6.3
Additional requirements		2.03	.82	1.71	

The dry matter in this trial ration is nearly up to the standard, but the protein is more than 25 per cent. too low. while the digestible carbohydrates and fat are about 10 per cent. too low. To make this ration more balanced it is therefore necessary to add a protein-rich food and, to keep the dry matter and the amount of grain within reasonable bounds it is necessary to use more protein-rich roughage like clover hay instead of so much poor roughage as oat straw.

To bring the ration in closer relation to the standard, the straw is dispensed with and there is added 5 pounds of clover hay, 1 pound of oats and 1½ pounds of oil meal. The ration then appears as follows:

SECOND TRIAL RATION

Feed		Lbs. Dry Matter	Dig. Protein	Dig. Fat and Carbohydrates	Nutritive Ratio
Silage	35 lbs.	9.21	.39	5.81	
Clover Hay	12 lbs.	10.45	.91	5.21	
Bran	3 lbs.	2.70	.38	1.45	
Oats	3 lbs.	2.72	.28	1.82	
Oil Meal	1½ lbs.	1.36	.45	.72	
		26.44	2.41	15.01	1:6.2
Standard		25.40	2.35	15.00	1:6.3
Difference		1.04	.06	.01	

This ration approximates the standard so closely that it may be considered well balanced, but since all the nutrients are a trifle high, experience would suggest that about a pound of the grain mixture be taken away and that for a couple of pounds of clover there be substituted as much straw as the animal would eat.

FACTORS LIMITING THE USE OF FEEDING STANDARDS

Individuality of Cows:—The application of feeding standards to actual practice must be done with considerable judgment, and feeding standards can not be slavishly followed. It is possible to figure rations that are mathematically correct, but the ability of individual cows to make the best use of their feed cannot be mathematically figured. This must be determined by the observation and judgment of the feeder. It is, also, not practicable to figure out rations for each individual cow in a herd, according to standards. The proper way to use the standard is to make up mixtures of the different concentrates (grains, etc.), according to standard for an average cow of the herd, and feed this mixture in proportion to the daily milk yield of the individual cows, then to give each cow all she will eat of the different roughages in about the proportions the standards recommend. If it is found that a cow is not producing up to expectation by this method, it is sometimes wise to reduce somewhat the amount of roughage, still feeding the grain in proportion to milk yield. This also applies to a cow that is getting too fat. Sometimes it is better to reduce the grain and by this method get as large or at any rate a more profitable return.

Palatability and Digestibility of Feeds:—A table of digestible nutrients of different feeds is not an entirely accurate account of the true values of the nutrients for use in the animal's body, for retaining life or producing milk. For instance, an examination of Table 3 shows that oat straw has about as much digestible carbohydrates and fat as bran, oats or clover hay, in the same dry matter. Now this is perfectly true as far as it goes, but it takes a great deal more of the animal's energy to digest and work up these nutrients in straw, than in the better feeds. This energy must come from the food, so that a pound of carbohydrates in straw is not nearly so valuable as a pound of the same nutrient in clover hay or bran. As a matter of fact, clover hay has nearly twice as much actual net digestible carbohydrates as oat straw, and wheat bran has two and one-half times as much net digestible carbohydrates as oat straw. These factors must be taken into consideration, and care must be exercised that the rations be not composed of too much hard-to-digest feeds like the different straws, even though the tables show them to have a large percentage of digestible nutrients. In general, it is safe to say, that the nutrients of the straw are only about half as valuable as equal amounts of the same nutrients in hay (clover or alfalfa) and only one-third to one-quarter as valuable as the same nutrients in the grains and concentrated feeds. This is due to the excess amount of woody matter, or fibre, in the straws. This fibre is a carbohydrate and is digestible but takes much more energy to digest it than do the other carbohydrates, the starches and sugars, that are present in large quantities in the grains and concentrates. In feeds that are not so mature, and that contain more water, such as silage and mangels there is not so much of this woody fibre and, as they are not so dry, they are more acceptable to the cow, hence called more palatable. The addition of these succulent feeds to rations containing all dry feeds make the whole ration more palatable, and therefore more digestible, and, as a rule, are the means of causing a larger increase in milk flow than their composition would seem to warrant. The milch cow always responds to feeds that she can eat with more pleasure. For this reason, the feeder should aim at providing a ration that answers this requirement even at the expense of deviating somewhat from the feeding standard.

Variety:—Like the human being, the cow likes and will respond to variety in feeds; that is, she likes a number of different kinds of feeds rather than too much of one feed, no matter how perfect that may be for the purpose, from its composition. Variety does not mean changing the feeds from one day to another. It means that in a whole day's ration a cow should have some succulent feed (mangels or silage) some dry fodder (hay and straw) and a mixture of two or more kinds of concentrates. Such variety will give cheaper and better returns than too much of any one kind of feed, even the best alfalfa or clover hay.

Characteristic Qualities of Different Feeds:— In addition to having a fairly uniform composition, many feeds have a characteristic effect on the health and well-being of the animal. These must be known and taken into account in making up rations and feeding same to milch cows. Such feeds as bran and oil cake have a beneficial laxative effect on the digestive system, and can always be fed with safety, and either one should be found in a heavy daily grain ration on this account. Cotton seed meal, on the other hand, has a tendency to constipate, and must, on this account, be fed with care that there is enough succulent food such as roots and silage, or a goodly share of some other laxative food such as bran or oil cake, to counteract this condition caused by cotton seed meal.

ARMSBY FEEDING STANDARD INVESTIGATIONS.

As has been pointed out, the feeding standards just dealt with have some weaknesses which prevent their precise application to all feeding problems. The outstanding weakness is the difference in the digestibility of the different nutrients in the various classes of feeding-stuffs. For example, the total quantity of digestible nutrients in oat straw is not equal in feeding value to the same quantity of like nutrients in wheat bran, because there is much more energy used up by the digestive system in working up and assimilating the nutrients of the former. To find, therefore, the actual net value of a feeding-stuff it is necessary to deduct the amount of energy required in digestion from the total energy of food value supplied by the digestible nutrients.

Investigations along this line are being carried out by Armsby, of the Pennsylvania Experiment Station. As this class of investigation is very, very slow, on account of its technical difficulties, only some of the various food-stuffs have been analyzed. As will be shown by the following table of foods analyzed, total dry matter and digestible protein are listed just as in the previous tables. But, as shown in the last column, foods are compared on the basis of their net energy, which is the energy available after the work of digestion and assimilation is provided for. This net energy is expressed in "therms", a term used by chemists to describe a certain unit of fuel or energy value in nutrition experiments.

TABLE IV—Armsby Table of Dry Matter, Digestible Protein and Net Energy Values in 100 lbs. of Various Feeding Stuffs.

Feeding Stuffs.	Total Dry Matter	Digestible Protein	Net Energy Value
Green fodder and silage:	lbs.	lbs.	Therms
Alfalfa	28.2	2.50	12.45
Clover, crimson	19.1	2.19	11.30
Clover, red	29.2	2.21	16.17
Corn fodder, green	20.7	.41	12.44
Corn silage	25.6	1.21	16.56
Hungarian grass	28.9	1.33	14.76
Rape	14.3	2.16	11.43
Timothy	38.4	1.04	19.08
Hay and dry coarse fodder:			
Alfalfa hay	91.6	6.93	34.41
Clover hay, red	84.7	5.41	34.74
Cowpea hay	89.3	8.57	42.76
Corn forage, field-cured	57.8	2.18	30.53
Corn stover	59.5	1.80	26.53
Hungarian hay	92.3	3.00	44.03
Oat hay	84.0	2.59	36.97
Timothy hay	86.8	2.05	33.56
Straws:			
Oat straw	90.8	1.09	21.21
Rye straw	92.9	.63	20.87
Wheat straw	90.4	.37	16.56
Roots and Tubers:			
Carrots	11.4	.37	7.82
Mangels	9.1	.14	4.62
Potatoes	21.1	.45	18.05
Turnips	9.4	.22	5.74
Grains:			
Barley	89.1	8.37	80.75
Corn	89.1	6.79	88.84
Corn-and-cob meal	84.9	4.53	72.05
Oats	89.0	8.36	66.27
Pea meal	89.5	16.77	71.75
Rye	88.4	8.12	81.72
Wheat	89.5	8.90	82.63
By-products:			
Brewers' grains, dried	92.0	19.04	60.01
Brewers' grains, wet	24.3	3.81	14.82
Buckwheat middlings	88.2	22.34	75.92
Cottonseed meal	91.8	35.15	84.20

TABLE IV—Armsby Table of Dry Matter, Digestible Protein and Net Energy Values in 100 lbs. of Various Feeding Stuffs.

Feeding Stuffs.	Total Dry Matter	Digestible Protein	Net Energy Value
Distillers' grains—dried—			
Principally corn	93.0	21.93	79.23
Principally rye	93.2	10.38	60.93
Gluten feed	91.9	19.95	79.32
Gluten meal—Chicago	90.5	33.09	78.49
Linseed meal, old process	90.8	27.54	78.92
Linseed meal, new process	90.1	29.26	74.67
Malt sprouts	89.8	12.36	46.33
Rye bran	88.2	11.35	56.65
Sugar-beet pulp, fresh	10.1	.63	7.77
Sugar-beet pulp, dried	93.6	6.80	60.10
Wheat bran	88.1	10.21	48.23
Wheat middlings	84.0	12.79	77.65

ARMSBY STANDARD FOR GROWING CATTLE

Age	Live Weight	Digestible Protein	Net Energy Value
Months	Lbs.	Lbs.	Therms
3	275	1.10	5.0
6	425	1.30	6.0
12	650	1.65	7.0
18	850	1.70	7.5
24	1000	1.75	8.0
30	1100	1.65	8.0

As the animal approaches maturity it does not require proportionately as much digestible nutrients as it did in the earlier stages of growth. It will be noticed that, though the animal has quadrupled in weight between the ages of three months and thirty months, it requires only 50 per cent. more digestible protein and 60 per cent. more therms of net energy value in food, partially due to the ever-increasing power of the digestive system to assimilate more bulky and coarser foods.

ARMSBY STANDARD FOR MILK COWS

Live Weight	For Maintenance		For each lb. of 4% milk add	
	Digestible Protein	Net Energy Value	Digestible Protein	Net Energy Value
Lbs.	Lbs.	Therms	Lbs.	Therms
750	.40	4.95	.05	.30
1000	.50	6.00	.05	.30
1250	.60	7.00	.05	.30
1500	.65	7.90	.05	.30

In addition to the above requirements, Armsby recommends that a 1000 pound cow should receive from 20 to 30 pounds of total dry matter per day, the amount depending on the amount of milk being produced. For this purpose the writer would advise consulting the modified Wolff-Lehman Standards on a previous page, Table 2.

McCOLLUM'S EXPERIMENTS

Recent investigations in nutrition have pointed out the limitations of the making of rations on the basis of chemical analysis of food-stuffs and the adaptations of protein and energy values of foods to the formulation of efficient rations particularly for the process of reproduction, the secretion of milk and the growth of the young animal. The recent researches of Professor E. V. McCollum of Johns Hopkins University, Baltimore, are especially noteworthy in this connection. This investigator has claimed that the seeds of plants such as wheat, oats, barley, corn and other much used cereals, the pea, bean and other legumes and the roots and tubers such as mangels, turnips and potatoes, no matter how complete they may be, whether singly or in mixtures, in the necessary protein, carbohydrate, fat and energy values for the building of complete rations on the basis of previously recognized feeding standards, do not appear in practice to promote growth to the fullest possible extent, especially in the young animal. On analysis these feeds contain all the constituents known to science to be necessary for proper growth, and these constituents are present in sufficient quantities for this purpose. Yet unless associated with such substances as milk, eggs or the leaves of plants which appear on analysis to contain exactly the same constituents though in different proportions, they do not induce the proper degree of growth or the most economical maintenance of the adult animal. He points out that these seeds, roots and tubers are mainly store houses of more or less inert food material for the successful start of a new generation of plants; that they contain very little living plant tissue except the germ of the seed, while the leaves of plants are composed of actual living plant cells and tissues of similar chemical constituent, it is true, but performing entirely different biological functions, namely the actual processes of growth and expansion of the plant; and milk and eggs are nature's perfect contribution to the successful early growth of the young animal and bird. It appears that the young animal requires for proper growth, and the adult requires for proper maintenance, the inclusion in its diet of a certain amount of the actual growth tissues of the plants on which it feeds, or a certain amount of such substances as milk and eggs. No chemical analysis has yet discovered these constituents that have such a stimulative or protective effect in animal and bird nutrition, but there appears no doubt they are present in solution in the fat of milk and eggs and water of milk and green plant leaves. In actual feeding practice this appears likely, as any feeder knows who has tried to raise young chicks or stimulate egg production by the use entirely of grain feeds. These methods have provided a certain amount of growth but not in the efficient manner accomplished by the feeding of milk and the rearing of chicks by natural methods of ranging with the hen.

In this connection, the feeding of dairy cows for milk production has not been subject to much difficulty regarding the supply of these unknown but necessary substances because the food of the cow consists of a large amount of hay and silage which, being leaves and stalks of plants, appear to provide the required amount of these substances.

In the rearing of calves however, further developments of these new researches may help to solve the problem of proper substitutes for milk in the early stages of growth.

Chapter VII

FEEDS FOR DAIRY CATTLE

Composition of Feeds—Farm Grown Grains—By-products and Concentrates—Dry Roughages—Silage Roots and Soiling Crops—Preparation of Feeds.

Composition of Feeds

THE following table gives in detail the composition of the different kinds of feeds commonly used in dairy cattle practice in Canada. This table in conjunction with Table 4, page 46, and along with the notes in this chapter dealing with the characteristics of the different foods may be of use in estimating and determining rations which are within the limits of safety and economy in the feeding of dairy cattle.

TABLE V.—Average Digestible Nutrients in 100 Lbs. of Feeding Stuffs.

Name of Feeds.	Total Dry Matter Lbs.	Digestible Protein Lbs.	Digestible Carbohydrates Fat x 2¼ Lbs.	Nutritive Ratio.
Corn	89.4	7.8	76.5	1-9.8
Corn-and-cob-meal	89.6	6.1	71.5	1-11.7
Wheat	89.5	8.8	70.8	1-8.0
Barley	89.2	8.4	68.9	1-8.2
Oats	90.8	9.7	60.7	1-6.7
Peas	85.0	19.7	50.2	1-2.54
Beans	87.2	18.3	56.1	1-3.1

TABLE V.—Average Digestible Nutrients in 100 Lbs. of Feeding Stuffs.

Name of Feeds.	Total Dry Matter Lbs.	Digestible Protein Lbs.	Digestible Carbohydrates Fat x 2¼ Lbs.	Nutritive Ratio.
Buckwheat	86.6	8.1	53.6	1-6.6
Gluten meal	90.5	29.7	56.2	1-1.9
Gluten feed	90.8	21.3	59.3	1-2.78
Linseed meal, old process	90.9	30.2	47.7	1-1.57
Cottonseed meal	93.0	37.6	43.0	1-1.14
Dried Brewers' grains	91.3	20.0	45.7	1-2.28
Wet Brewers' grains .	23.0	4.9	13.22	1-2.7
Dried Distillers' grains	92.4	22.8	65.8	1-2.88
Malt sprouts	90.5	20.3	49.1	1-2.4
Buckwheat middlings .	87.2	22.7	51.22	1-2.25
Wheat middlings ...	88.8	13.0	55.82	1-4.29
Bran	89.9	12.5	48.4	1-4.0
Clover hay	87.1	7.6	43.4	1-5.9
Timothy hay ...	[illegible]	2.8	45.8	1-16.2
Alfalfa hay . .	[illegible]	10.5	42.52	1-4.05
Millet hay . .	[illegible]	5.2	40.4	1-7.7
Clover (gr[illegible]	[illegible]	2.9	15.16	1-5.23
Timothy ([illegible]	[illegible]	1.5	21.25	1-14.1
Alfalfa (g[illegible]	[illegible]	3.6	13.0	1-3.6
Millet (green) .	[illegible]	1.6	15.07	1-9.4
Oat straw	[illegible]	1.0	44.6	1-31.8
Rye straw	[illegible]	0.7	40.5	1-58.0
Wheat straw	90.4	0.8	36.1	1-45.0
Barley straw	85.8	0.9	41.45	1-46.0
Oat hay	86.0	4.7	40.5	1-8.62
Oat forage (green) ..	25.0	2.6	12.35	1-4.75
Blue grass (Kentucky.	34.9	2.8	21.5	1-7.7
Pasture grass	20.0	2.5	11.2	1-4.5
Corn stover	59.5	1.4	32.77	1-23.4
Corn fodder	81.7	3.0	50.67	1-16.7
Corn silage (well matured)	26.3	1.1	16.6	1-15.0
Corn silage (immature)	21.0	1.0	12.8	1-12.8
Turnips	9.5	1.0	64.5	1-6.4
Mangels	9.4	0.8	6.62	1-8.2
Sorgum (green)	24.9	0.7	15.4	1-22.1
Whole milk	13.6	3.3	14.57	1-4.4
Skim milk	9.9	3.6	5.55	1-1.5
Buttermilk	9.4	3.4	5.12	1-1.5
Whey	6.6	0.8	5.37	1-6.8
Beet pulp (dry)......	91.8	4.6	67.	1-14.6
Beet pulp (wet)......	9.8	.5	6.9	1-13.8

(E)

It is impossible within the scope of a work of this size to give in detail all the investigation work with the different feeds for dairy cattle, but an endeavour will be made to summarize the experiments in conjunction with facts gleaned from the experience of feeders so that the average dairyman may be assisted to feed his cattle to best advantage knowing the qualities and costs of the feeds at hand.

FARM GROWN GRAINS.

Corn:—This grain, though comparatively low in protein, is extremely rich in easily digestible carbohydrates and fat. It is palatable and easily masticated, but on account of its low protein content and heavy nature, it should not form more than half of the grain ration. It is valuable in a ration if mixed with bran, oats, or brewer's grains, all of which tend to lighten up the ration and give more bulk for the same weight. The Maryland Experiment Station finds that cows gave, in a year, 33 per cent. more milk and 45 per cent. more butter on a ration consisting of wheat, bran, gluten feed and corn than on the same quantity of cornmeal, the rough feeds being the same in both cases. Where the roughage contains plenty of clover or alfalfa hay, corn may be fed in larger quantities than in a ration with timothy or other low protein hay. The Illinois Experiment Station found that a ration consisting of eight pounds of gluten feed and cornmeal, with clover hay and silage, produced 40 per cent. more milk and butter fat than eight pounds of cornmeal alone with timothy hay, a little clover and silage. Corn, on account of its palatability and high digestibility, is valuable as a part of the grain ration when fed with high protein concentrates and clover or alfalfa roughage. If fed in the shape of corn and cob meal, corn gives better results if other bulky concentrates are not available, as the cob tends to lighten up the heavy cornmeal. On account of the high percentage of easily digested carbohydrates and fat, corn is a valuable supplement for feeding with skim milk to growing calves. The Iowa Experiment Station found that 1.3 pounds corn meal with 1.10 pounds of flaxseed gave better gains on calves fed skim milk than 1.2 pounds of linseed, and equally as good gains as 1.5 pounds of oats fed with skim milk.

Barley:—This grain, found on nearly every Ontario farm, can be fed to advantage within certain limits, for milk production. The Ontario Agricultural College found that barley gives almost equally good results as oats when fed as half the grain ration, with bran. Like corn, barley contains a large proportion of easily digestible carbohydrates, but contains 10 per cent. more protein and about half as much fat. It is also of a heavy nature when ground, and is better made lighter by the addition of bran, oats or brewers' grains. On account of its tendency to heat the animal, it is usually not wise to feed just previous to freshening or immediately after, especially if the cow's udder is swollen or inflamed.

Wheat:—Wheat is usually too high a price to feed in any quantity for the production of milk. If of poor quality to sell, however, it may be fed to advantage. The Maine Experiment Station found that wheat was of equal value with corn, pound for pound, for the production of both milk and fat, while Danish experiments show that wheat is nearly equal to a mixture of equal parts oats and barley, for the same purpose. Elevator screenings, containing more or less wheat, some other grains, and black seeds, were experimented with by the Experimental Farm at Ottawa in 1914. It was found that screenings containing 65 per cent. wheat and 25 per cent. other grains, balance weed seeds and chaff, was equal to a mixture of bran 4 parts, gluten feed 2 parts, oil cake 1 part, cottonseed 1 part, when fed as one-third of the daily grain ration, the other two-thirds of which was the mixture mentioned above. Where the screenings consisted largely of black seeds and other offal it was found that, owing to the unpalatability and bitter taste, many cows would not eat their grain even though the screenings were only one-third of the grain ration. The value of wheat screenings depends on the proportion of weed seeds therein.

Oats:—Owing to the large quantity of oats grown on Canadian farms, this grain occupies a commanding position as a food for dairy cattle of all ages. It contains a larger proportion of protein than any other farm-grown grain except peas; it has a larger proportion of hull than any other grains which, when ground, adds the lightness and bulk so desirable in rations for producing milk, and they have a flavour and palatability that makes them peculiarly acceptable to all classes of live stock. No other single grain is so satisfactory and safe for feeding purposes. Experiments of the Wisconsin Station show that oats produced 10 per cent. more milk and fat than an equal weight of bran when fed with clover hay and corn fodder as roughage. With a roughage ration consisting of timothy hay and corn fodder, which contains less protein than the above, the bran would be more valuable, as it contains a larger amount of digestible protein than oats. The Massachusetts Station reports that fed with 3.2 pounds of bran and 14.5 pounds of mixed hay, 4.5 pounds of oats was equal to the same weight of corn meal for milk production.

Oats have always been found a very valuable feed in the rearing of calves. The high protein content accompanied by a large proportion of ash, makes this grain eminently suitable for the growth of bone and muscle necessary in the raising of young animals, while the lightness of the grain aids in avoiding digestive troubles. The Iowa Experiment Station found that with skim milk, 1½ pounds of oat meal made as large as, and cheaper gains, than 1.2 pounds of linseed meal, or 1.3 pounds of corn meal, and 1.10 of a pound of flaxseed, when fed to calves over two months old. In a census of breeders of Guernsey cattle conducted by the American Guernsey Cattle Club, it was found that 60 per cent. used oats as half or more of their rations for raising calves. While the calf is under seven or eight months of age, whole oats give equal satisfaction as ground oats. After that age mastication is not so perfect and ground or rolled grain is preferable.

Although this grain is so satisfactory in milk production, it often happens that the price is too high, caused by the demand for horse feed and human consumption. In this case, some of the more concentrated feeds such as oil meal and cottonseed meal are cheaper sources of protein, while bulk and lightness, combined with high protein content, may be more cheaply procured by using brewer's grains or gluten feed. At the same time, the feed value of oats in this connection usually warrants using at a fairly high price, especially for calves and growing stock and cows being fed on long-time tests.

Peas:—The price of this grain for the past ten years has prohibited its use as a general feed for milk production. Peas, however, are one of the best stimulants of the milk-producing faculty, and in spite of the high price are used in feeding cows for high milk and butter fat records. This grain contains a very high percentage of protein and is rich in fat, carbohydrates and ash. They are easily digested but on account of their heavy nature when ground, they must be lightened up with some fibrous grain, such as bran or oats.

Buckwheat:—This grain is not fed to any great extent in Ontario. It is more suitable for fattening purposes than for milk production. At the same time, where this grain is available it may be fed to advantage as part of the grain ration, taking the place of part of the corn, barley or oats. When fed in large quantities it is supposed to injure the quality of the butter. Buckwheat bran, the hull of the grain, is practically worthless for feeding cows, but buckwheat middlings, or that portion immediately within the hull, has been found to be equal to a mixture of equal parts corn and bran, when fed as part of a balanced ration. The middlings, however, are not particularly relished by the cattle, and if fed in too large quantities have the same effect on the butter as the buckwheat itself.

Rye:—This is probably the most unsatisfactory of all farm-grown grains for milk production. It is not much relished by the cattle; it tends to produce a hard, dry butter, and is a more frequent cause of digestive troubles than any other of the cereals. Neither has it the feeding value of the other grains. However, if available at a low price, it might help to cheapen the ration, by partially replacing some of the other grains.

Emmer:—The South Dakota Experiment Station reports that emmer is 12 to 15 per cent. less efficient for the production of milk than either barley or corn meal. This grain appears to have no injurious effect on the product of the dairy or the health of the animals, and as it is bulky in nature can be fed with safety as part of a ration.

VARIOUS BY-PRODUCTS AND CONCENTRATES.

Bran:—This is the best known and most widely used of all by-products, for milk production. In addition to supplying a large amount of protein and ash, it is mildly laxative in its nature, it is light and open in its character, and may be fed in any amount with safety, either alone or in combination with other grains, to dairy cattle of any age and condition. Bran is about equal in value for milk production to a like weight of oats and barley, and is only slightly behind oats alone. It is especially valuable to feed with rich carbohydrate grains, such as corn, rye and barley. On account of its beneficial effect on the digestive system, it is particularly valuable for cows just before and after calving; as part of the heavy grain ration necessary to heavy milking cows on test; and to growing animals. Although becoming high in price, this feed will occupy first place for some time to come as the most important concentrate in milk production and in rearing dairy animals.

Middlings or Shorts:—This feed is a little richer than bran in most of the valuable nutrients, but its heavy, sticky texture, detracts considerably from its value as a feed, when fed in large quantities. It is not valuable therefore, for giving bulk and openness to a grain ration. However, when it can be purchased at about the price of bran it will yield good returns when fed as part of the meal, with oats or barley. There is quite a variation in the various grades of middlings, some of them being principally finely-ground bran adulterated with mill sweepings and dust. This is of less value than bran for feeding purposes. Good wheat middlings, or shorts, are fine and flour-like in texture and lighter colored than bran. They are not so suitable for feeding calves as bran, on accunt of their sticky nature.

Dried Brewers' Grains:—These grains are largely the residue from barley, after the removal of the soluble sugars and starch, for the manufacture of malt liquors. They contain nearly twice as much protein as wheat bran, but are lacking in the valuable carbohydrates such as sugars and starch. The carbohydrates found in this feed are of the more indigestible kind, such as woody fibre, etc. On account of their high protein content, the grains are especially valuable for milk production. The Ontario Agricultural College found dried brewers' grains slightly superior to an equal weight of bran, for milk production. The Vermont Experiment Station reports that dried brewers' grains and bran are equal to a mixture of cottonseed meal, linseed meal and wheat bran. On account of the great amount of fibre, however, they are not quite as satisfactory as bran, when fed as the larger part, or the whole, of the grain ration. They are, however, very palatable and much liked by the cows and, on account of their dryness and bulky nature, are valuable to lighten up a heavy meal ration. They may also be stored for a long period, in large quantities, without spoiling.

Wet Brewers' Grains:—These grains have a high value for milk production, if fed when fresh. On account of the great amount of water contained, they must of necessity be used almost entirely within easy hauling distance of the breweries. About 25 pounds per day, per cow, can be fed, if the animals have a good supply of dry hay, little other grain being necessary. They decay and become so foul, however, in a few days that feeding should be done only in concrete or other water-tight mangers, and should never be stored for more than a week at the very most. The odours arising from spoiling grains are the frequent cause of bad flavours in milk and butter.

Distillers' Grains:—In this country this feed is largely derived from rye. They are bulky as wheat bran, contain about as much fibre, but are richer in digestible protein and in fat. They are not as palatable, and on account of a sour taste and smell it is quite difficult to get cows accustomed to eat them in large quantities. Both the Massachusetts and Vermont Stations report that when mixed with equal amounts of bran they produce about six per cent. more milk than an equal amount of gluten feed, and that when fed alone they produced 12 per cent. more milk and fat than an equal amount of corn meal and bran, and nearly as much milk as a mixture of cottonseed meal and bran. They are worth slightly more than dried brewers' grains, but not being acceptable to many cows, detracts considerably from their feeding value. They are largely used in the make up of many of the patent dairy feeds, and also to some extent by the feeders of high record cows, as a cheap source of protein and to add variety to the rations, a valuable consideration in such a line of work.

Malt Sprouts:—Though not commonly used, malt sprouts may be fed in limited amounts, if purchased at a reasonable price. The Massachusetts Station reports that they are equal to about 75 per cent. the same weight of gluten feed, when fed to milk cows as part of their grain ration. Great difficulty is often experienced in getting cows to eat them, on account of a bitter taste, and when fed in large quantities they impart a bitter flavour to the milk. As they absorb a large amount of water they should always be soaked before feeding. As a rule, the dairyman would not be justified in feeding them unless they could be procured at less than three-quarters the price of bran and oats.

Buckwheat Middlings:—If of a good quality and containing very little buckwheat bran or hulls, these middlings are a valuable milk producer. The Vermont Station finds that they produce 8 to 11 per cent. more milk than an equal weight of cornmeal and bran. As cows do not relish them when fed in large allowances, they should form only part of the grain ration, with bran, oats or brewers' grains to lighten them up. Fed in this way they have no injurious effect on the quality of the milk or butter. In purchasing this feed care must be exercised to procure bright, floury quality, as they are commonly adulterated with buckwheat bran or hulls which, on account of their woody nature, have practically no feeding value.

Gluten Feed:—The best known by-product of corn in this country is gluten feed, which is a by-product from the manufacture of starch from corn. It contains all that is left of the corn after the starch is removed, except the germ. High-grade gluten feed is a very valuable product, containing a high percentage of protein and only a moderate amount of fibre. The low grade gluten feed is not worth so much by a good deal, and buyers should be on the watch in this connection, and should see to it that a satisfactory guarantee as to composition accompanies the feed. Gluten feed is especially valuable for dairy cows in milk, being usually a cheap source of protein and reasonably light and bulky. The Vermont Station finds gluten feed produced 15 per cent. more milk and butter than an equal weight of cornmeal and bran. As a source of protein, the high grade feed is worth 20 per cent. more per ton than bran, but as it is not so laxative in its nature, it is most valuable in forming part of the ration mixed with bran. There is occasionally sold, in this country, Continental gluten feed, which is a by-product in the distillation of alcohol from corn. This feed has nearly the same feeding value as gluten feed, but it is not quite so well relished by cows, so it cannot be profitably fed in large quantities.

Gluten Meal:—This feed is seldom sold in this country. It consists entirely of the gluten of corn without the admixture of corn bran, as is found in gluten feed. This meal is heavy in its nature, but as part of the grain ration it is almost equal to oil cake in its ability to produce milk.

Cottonseed Meal:—Of all concentrates high grade cottonseed meal is the cheapest source of

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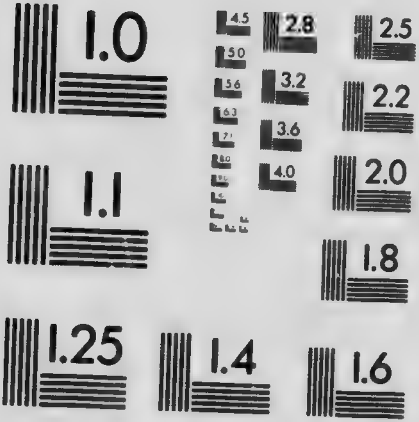

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highly digestible protein, and is therefore, one of the best stimulants of milk production yet known. Regarding cottonseed meal it must be remembered that it is valuable for a specific purpose, and that is for increasing the protein content of a ration. Cottonseed meal is not suitable for all classes of stock, and for any class of stock it should be used in moderation. Dairy cows or fattening cattle will take two pounds per day, per head, without any injury. It is true this quantity is often exceeded, but when a person is feeding three pounds or more of cottonseed meal to a cow per day he is venturing on dangerous ground. For calves and pigs, cottonseed meal had better not be used at all. It is true these animals may be fed very small amounts in their ration, but in this country we do not need to use it, and hence it is not worth while running risks. The danger in cottonseed meal lies in its highly constipating nature. For this reason it is usually unwise to feed it except where considerable quantities of silage or roots are found in the ration, or in combination with some other laxative concentrate such as oilcake or wheat bran. With feeds of this kind it has been fully demonstrated by experience and feeding trials that good cottonseed meal will displace twice its weight in wheat bran, or dried brewers' grains, with equally good returns in the pail. In general, to form part of a ration, the farmer is justified in paying from 60 to 75 per cent. more per ton for cottonseed meal than for bran, oats or dried brewers' grains. Cottonseed meal is not, by any means, a constant term. That is to say there are numerous grades of cottonseed meal on the market. In the cold pressed cottonseed cake and in cottonseed feed the percentage of fibre is nearly as high as the percentage of protein. A good brand of cottonseed meal containing 40 per cent. or more of protein is worth twice as much per ton as cold pressed cottonseed cake or cottonseed feed. In fact, the two last mentioned grades of feed are not worth a great deal more per ton than wheat bran. It is true they contain much more protein and fat, but their percentage of fibre is so high that it cuts down their value very materially. Those who are buying cottonseed meal should pay careful attention to the percentage of protein and of fibre, and not be misled into thinking that because the feed in question has a fairly high percentage of protein it is necessarily a valuable feed. It may have so much fibre that its feeding value is seriously reduced. Cottonseed hulls are but little better than worthless as a concentrate feeding stuff.

Flaxseed:—Flaxseed, at present, is so high in price that it is not used to any extent for feeding purposes. In some cases where it is grown at home small amounts are used. It will be noted that flaxseed is extremely high in fat as well as fairly high in protein. The fat is extracted, giving us linseed oil, and the residue is known as linseed meal or oilcake. On account of the high percentage of fat, flaxseed is most commonly used in feeding skim-milk calves, as a substitute for the butter fat. For this purpose it is better boiled to a jelly-like consistency and mixed with skim-milk for young calves. When calves are eating grain, the flaxseed may be fed dry, either whole or ground in a tight manger.

Oil Cake, Oil Meal, or Linseed Meal:—These three names apply to the same product. This by-product of flaxseed contains a big percentage of protein and a fair amount of fat. It does not contain so much protein as high grade cottonseed meal, but it does not possess any of the dangerous properties of cottonseed meal, and when fed to stock its tends to bring about a general thrifty condition in the animal. Owing to this fact, most feeders prefer linseed meal to cottonseed meal, though it is lower in protein. As a source of protein for dairy cows cottonseed meal is more economical, and it is only on the ground that linseed meal can be fed to any class of animals, and tends to promote thrift, that we can justify paying as much per ton for this product as for high class cottonseed meal. It is useful for increasing the protein in the ration of young pigs, calves, dairy cattle low in condition, and for cows just previous to and immediately after calving. It is also extensively used in fitting animals for show and for the sale ring, as its use tends to produce mellowness of hair and hide and general evidence of thrift. For feeding to young growing animals in small quantities, with oats, corn, or bran, it is unsurpassed. As a stimulator of milk flow it is not quite equal to cottonseed meal, but on account of its wide use as much may be paid for it as cottonseed meal.

Dried Beet Pulp:—This feed is a by-product in the manufacture of sugar from beets. It is rather high in fibre, though containing a fair amount of protein. When thoroughly soaked with water it provides a succulent food, when roots or silage are lacking. It is worth about two-thirds as much per ton as wheat bran.

Molasses Feeds:—There is a wide range of these sold, both as to name and as to quality. They consist of various products, some high class, such as cottonseed meal, many other of very low grade, such as oat hulls, cottonseed hulls, and mill screenings, combined with molasses. Many of them contain a very large amount of foul weed seeds, and most of them are sold at prices away above their actual value for feeding purposes. Some of the better quality brands have a useful tonic value if fed in small quantities, and they are often used for this purpose in feeding for high records. In general, the average dairyman is wise in leaving these feeds entirely alone unless he is in a position to judge of the merits of the different kinds.

DRY ROUGHAGES

Red Clover Hay:—On account of its general use, this forage can be considered the most important of the crops fed in the dry rough state for milk production. For a bulky feed it contains a high percentage of digestible protein. It can be profitably fed to dairy stock of all ages, from calves to cows in full flow of milk. Liberal feeding of red clover hay will allow of the reduction in the amount of the concentrated feed in providing a well balanced ration. The substitution of clover hay for timothy, blue grass hay, or other grasses, will effect a saving in the amount of meal fed to produce a given amount of milk. For raising young stock, red clover hay provides a well-balanced ration in itself. The quality of clover hay depends largely on the condition in which it is stored. If cut in full bloom, and well saved without being rained on, or bleached from over-exposure to the sun, it is twice as valuable as that cut when ripe and dry, or unduly exposed to rain and sun. The thicker the stand of clover on the ground the finer will be the growth and also the feeding quality.

Alsike Clover:—Of much the same composition as red clover, it would be of equal value for milk production except that it is not so palatable and acceptable to the cows. As it does well on damp soil and lasts longer on the ground than red clover, it is usually wise to include a couple of pounds of alsike in the grass seed mixture of all Ontario farms. Threshed clover hay of both kinds has very little more feeding value than barley or wheat straw, for milk cows.

Crimson Clover:—This plant is grown very little as a hay crop in this country. Where grown, care must be taken to cut it before any of the blossoms commence to die, because the small barbed hairs on the blossoms and stems become very hard and wiry when ripe and are liable to mat together in the stomach and cause serious digestive troubles. Crimson clover has a very early spring growth and is valuable as a pasture or soiling crop at this period.

Mammoth Clover:—On account of its rank coarse growth, and late maturing, this feed has by no means as high value as red or alsike clover. It thrives well on poor and light soils but yields only one cutting per year.

Alfalfa Hay:—Good alfalfa hay is beyond doubt the best roughage for milk production. It is very rich in available protein and of high palatability. In composition it compares very favorably with bran, but having a higher percentage of fibre, which affects the digestibility of the other constituents, one is hardly justified in saying that it is equal to bran in producing milk. It has been thoroughly proven that good alfalfa hay can replace with profit a considerable part of the concentrate or grain allowance in any ration not containing alfalfa. The Ohio Station found that twelve pounds of alfalfa, when fed with corn silage and six pounds of cornmeal, per day, produced as much milk as six pounds of corn stover and nine and a half pounds of a rich texture of cottonseed meal, bran, and corn meal. The New Jersey Station found that 14 pounds of alfalfa replaced 8½ pounds of wheat bran, dried brewers' grains and cottonseed meal, 7 pounds of corn stover and 5 pounds of corn silage, with almost equally good results in milk and fat. In experiments made in feeding of alfalfa hay in place of grain or concentrates it has been generally found that with cows of only moderate production, milk can be produced very cheaply where alfalfa hay is plentiful. It was noted, however, that the animals did not maintain the highest degree of health, due possibly to the non-supply of high digestible carbohydrates and the high percentage of fibre. With heavy milking herds it has been proved that larger and cheaper production and better health is maintained by the feeding of some concentrates in addition to the alfalfa. In deciding just how far to go along the line of alfalfa feeding, the farmer must take into account the productivity of his cows and the price of alfalfa hay as compared with protein-rich concentrates Alfalfa is also especially valuable for young dairy stock and dry cows. It should, however, be harvested just as it is commencing to bloom, to produce the best quality of hay. The second cutting in this country is usually of a little better quality than the first, most likely on account of generally better weather for curing at that time, and also to some extent on account of the more fine and leafy nature of its growth. Although alfalfa has not all the magic properties sometimes ascribed to it, the dairyman who can grow it successfully, or buy it cheaply, has at his command the best roughage for his purpose.

Sweet Clover:—White sweet clover when cut early is a valuable roughage for milk production and as a pasture crop. As a dry feed it is not quite so palatable as alfalfa or red clover, on account of a slight bitter taste, but cattle can be easily accustomed to its use. This crop will thrive well on poor soils. The yellow variety is neither as prolific nor as acceptable to animals as the white, and its growth is not to be strongly advised. As a pasture crop, sweet clover is proving to be especially valuable and it is believed by many well informed observers that this plant will solve the problem of midsummer pasture in Eastern Canada. Dry hot spells affect this crop less than any other crop used for pasture purposes and it is not unusual to see sweet clover pastures supporting nearly one cow to the acre in the middle of summer in Ontario.

Pea and Oat Hay:—This is a variety of hay whose high standard of value is not generally recognized. It is rich in protein and very much relished by stock. Where clover meadows have failed to come through the winter safely the growing of this hay is strongly to be advised, as it will greatly assist in providing a large amount of cheap succulent roughage for winter feeding. It should be cut when the peas are in full bloom and the oats in the milk stage.

Timothy:—This widely known hay has not equal value with the clovers for the feeding of cows in milk. However, on account of its palatability, the relish with which all stock consume it and its prevalence, it is valuable for calves and young stock generally. It is rather low in protein to stimulate milk flow, but it contains a large proportion of digestible carbohydrates. Its use, therefore, in a ration entails the addition of some protein-rich concentrate, such as oil meal, to balance it properly.

Canadian Blue Grass:—This hay is plentiful in some parts of Ontario, and is a valuable feed for growing and fattening stock, and as a milk producer, is somewhat superior to timothy. It is valuable as a nutritious early pasture that stands drought reasonably well, but as a hay crop it does not yield heavily and there is usually no aftermath.

Kentucky Blue Grass:—As a hay crop Kentucky Blue is about equal to Canadian Blue for feeding purposes. As a pasture grass it is one of the very best, especially early in the season. It should be included in every permanent pasture mixture on account of its dense early growth.

Millet:—The different varieties of millet and Hungarian grass are grown usually as catch crops, where, on account of adverse conditions, it is impracticable to grow other crops. When sown thickly so that the growth is not too coarse, and cut a little on the green side, millet makes a valuable hay that ranks just a little better than timothy for milk production and for young and dry stock. Millet, on account of its rapid growth, is a valuable soiling crop to cut green for supplementing dry pastures, as it can be sown late enough to reach its greatest growth during the month of August when pastures are poorest, when clover, peas, and oats have become too mature, and corn has not yet reached sufficient maturity to be profitably fed.

Straw and Chaff:—The noticeable feature of the composition of straw is the extremely high percentage of fibre. As a result, when we feed animals largely upon straw they have to handle a very large amount of what may be called inert or comparatively useless material. While this is true, it is also true that straw may be used as part of the bulky ration to good advantage, when other bulky fodders are scarce or very high in price. It must be remembered that if straw is used in the ration of dairy cows in milk it will be necessary to feed a good deal more meal than when hay is fed, so that sometimes what we may gain in saving hay may be more than lost through the extra amount of concentrates used. For store cattle or dry cows, straw can be used to much better advantage than for cows which are milking or cattle which are being fattened.

Of the different kinds of straw buckwheat supplies the most protein, but is so extremely high in fibre that it is seldom regarded as a satisfactory feed for stock, except in extreme cases. Everything considered, oat straw is the most satisfactory for all classes of stock.

Barley straw is practically equal to oat straw so far as composition is concerned, but barley straw is not so palatable as oat straw and the awns or beards of the barley render it objectionable.

Wheat straw and rye straw are both rather low in feeding value and should not be used for feed if oat straw is available. The chaff of oat and wheat straw has a much higher value for feed than the straw itself and if at hand in any quantity can be fed with a considerable saving in hay or other high class roughage. Pea straw has a very high feeding value, but coming from the modern thresher it is usually very dusty, which detracts from its palatability.

Corn Fodder:—Because of the large tonnage that can be harvested from an acre, and the comparative ease with which it can be cured, corn fodder is one of the most valuable roughages at the command of the Canadian farmer. When well matured, and cut and cured with the ears on the stalks, corn fodder has a value, in the late fall and early winter, equal to timothy hay for milk production, and the profitable growing of young stock. As it becomes dried out in winter it is much improved by cutting a few days' supply into a large heap, which, on account of the heat generated, spreads the moisture through the dry butts, leaves and cobs, and softens up those parts so they are more readily eaten and digested than if fed whole. In the feeding of uncut fodder, the butts of the stalks which contain valuable material are usually left uneaten. While for practically all purposes the same corn put in the silo would give better results, where corn is grown for fodder it is advisable to plant thicker than where grown for silage. The thicker sowing will produce a smaller growth of stalk and more leaves and a slightly higher tonnage per acre.

The Pennsylvania Station reports that corn fodder is nearly equal, pound for pound, with timothy hay for the production of milk and fat when both were fed with a grain ration of equal parts oats and bran. The Utah Station found that corn fodder would replace nearly half the alfalfa in a ration of 21 pounds of alfalfa hay, with bran and wheat or cornmeal, producing practically as much milk and butter fat.

The main value of fodder corn lies in its ability to cheapen a ration by replacing part of the more high priced hay with equal results in milk production and growth. It must not be forgotten that corn fodder or silage, no matter how good, will not economically replace in a ration the entire amount of hay or other high class roughage.

Corn Stover:—Corn Stover consists of the cured corn stalks after the removal of the ears. As might be expected, this feed has not as high a value as good corn fodder which contains the ears. The fact that this crop is usually allowed to mature to a greater extent than fodder corn, often being frozen before cutting, detracts also from its feeding value. In spite of these conditions, corn stover has a feeding value much greater than straw. Henry of Wisconsin, found that one ton of uncut corn stover was slightly superior to one-third of a ton of mixed clover and timothy hay, and nearly equal to one-third of a ton of clover hay. He also found that cutting the stover increased its value, as less of the coarse parts of the stalks was wasted.

Corn Silage:—This feed occupies a high place in the feeding of dairy cattle in Ontario conditions. To such an extent is this so, that the writer feels confident in asserting that without corn silage dairying, as generally conducted in Ontario, could not, at present prices for dairy products, be profitably conducted. The great amount of actual feeding material that can be raised per acre, the efficient manner in which the silo stores and cures the feed, the convenience of the silo for feeding at all times of the year, give silage its great economic value. In addition it is important to know that silage, being a succulent food, is cooling and laxative in its action, helping greatly to keep the digestive system of the cow in good condition, and being an appetizer it helps the animal to consume larger quantities of food than she otherwise would. These are important considerations, especially in milk production.

Experiments conducted in most experiment stations in Northern United States and Canada, confirm the finding that for milk production corn silage is worth from 8 to 12 per cent. more than an equal amount of dry matter in good corn fodder. The Maine and Vermont Stations both reported that from three to three and a half pounds of silage is equal to a pound of mixed hay in replacing part of the hay in a ration. The Utah Station found that where cows were getting alfalfa hay and grain that one-third of the alfalfa hay could be replaced by silage at the rate of about three pounds of silage to one pound of alfalfa, and equal production of milk could be maintained. This also gives corn silage a value per ton about one-third of that of alfalfa hay in replacing part of the more high-priced roughage. Owing to its rather low protein content, and high water content, corn silage is not a perfect ration by itself, its main usefulness being its efficiency in providing a bulky, succulent, appetizing roughage that will take the place, at a lower cost, of part of the more costly roughages, such as clover, timothy and alfalfa.

It is now definitely known that silage from well matured corn has a much higher feeding value than silage from green immature corn. The writer found, at the Ontario Agricultural College, that, for milk production, silage from White Cap Dent Corn, in the firm dough stage was worth nearly $1.20 per ton more than corn from Southern Sweet on which the ears were just forming. As there was a difference of only one-half ton per acre, in the yield of silage, this was a clear demonstration of the value of the well matured varieties of corn. It is also pretty well established that reasonably thick planting of corn for ensilage, say up to one-third bushel per acre, will produce more feed of nearly equal value, than will the thin planting such as is practised where corn is grown for grain.

Oats, Peas and Vetches Silage:—Silage from a mixture of oats, peas, and vetches has proven of very high value, in those localities where corn cannot be successfully matured for silage. This applies particularly to the New Ontario district. The Nova Scotia Agricultural College reports very highly on this feed and considers it equal in value to corn silage for milk production. Although the yield per acre is large, it does not quite equal corn in this respect, and on that account can scarcely be recommended for general use in older Ontario.

Silage from other Crops: — The ensiling of other crops, such as rye, clover or alfalfa, has been attempted with varying degrees of success. It has been found that clover and alfalfa deteriorate greatly in feeding value during the ensiling process, particularly in their protein constituent, nor has ensilage from these crops been found always palatable and acceptable to cattle. It is fair to assume that these crops are more useful when harvested and cured in the usual way.

Rye silage has been tested with no great degree of success, both at Guelph College and at the Vermont Experimental Station.

The refuse from canning factories, such as corn husks and cobs, and the green straw from peas, can be ensiled with success, and have been proven most satisfactory for dairy cows, but on account of their bulky character their use is limited to the districts immediately surrounding the factories.

Roots:—These foods belong to what are known as succulent foods; that is to say, all the members of the group of roots contain a very high percentage of water. The high percentage of water reduces the value of one hundred pounds of any of these foods, but the solid material which they furnish is usually very digestible and palatable. In addition, these succulent foods tend to keep the digestive organs of the animal in better condition and consequently they have a value outside of their actual feeding value. All practical feeders recognize the importance of succulent foods as a means of keeping animals in healthy, thrifty condition. While the dry matter in roots is somewhat more valuable than in corn silage, on account of the greater amount of the latter that can be raised from the same land, with less labor, the production of milk generally speaking is not so profitable from roots as from silage. However, it is safe to say that the addition of some roots to a ration for cows adds much to its palatability and succulence, and allows the cutting down of the concentrate allowance to some extent. Generally speaking, mangels are the most satisfactory for feeding cows in milk. Their actual feeding value is no greater than turnips, but they have not the same bad influence on the taste of the milk that is attributed to turnips. When hay is scarce, or high priced, mangels or turnips are useful for mixing with cut straw, to add palatability and to increase the consumption of the straw. In this way the amount of dry matter needed in the ration can be provided at a smaller cost than if necessary to feed large quantities of hay.

For feeding cows on official test, roots have an especially beneficial action. Their laxative, succulent nature, and their ability to whet the appetite to the consumption of heavy rations, lend them a very high value for this purpose.

Potatoes:—This crop is nearly always too high priced for feeding cattle. In addition, when fed in large quantity they have an injurious effect on the flavor of milk and texture of butter. They are occasionally useful in feeding to sick cows, as they are sometimes readily eaten when everything else is refused.

PREPARATION OF FOODS

It is often interesting to know to what extent such preparation of feeds as grinding or rolling grain, cutting straw or hay, cutting or pulping roots, soaking or cooking the various feed-stuffs, can be profitably carried on. In the first place, these operations demand the expenditure of labor and power, and the use of increased equipment. All of these commodities are expensive now-a-days, so that there is required a much increased feeding value in feed being so prepared to justify the increased expenditure. For feeding cows, the hard brittle nature of most of our grains, and the tough leathery hulls on the others practically demand the grinding and chopping of such to increase palatability and ease of digestion, and also to reduce to a minimum the amount that is liable to pass through the system undigested. The only noteworthy exception to the above is the feeding of oats to calves. The calf has a wonderfully efficient system of mastication that can quite readily handle the tough oat hull and hard oat kernel.

The practice of cutting hay has very little justification, unless it be of poor quality and its desired to mix it with silage or roots to increase its consumption. The cutting of hay makes it dusty and therefore less acceptable to the cows, which fact is quite evident to all who have seen the enjoyment with which cows always consume good long clover or alfalfa hay. Cutting detracts from its feeding value, and adds to the cost of feeding operations.

Where only a limited amount of straw is being fed, there is little necessity of incurring the expense of cutting, but where it is necessary to feed a large amount, greater consumption of this roughage can be accomplished by cutting and mixing with roots or silage, or both. If this mixture be allowed to stand in the pile to heat for a few days, the straw portion is made more palatable.

The cutting of dry corn fodder, as has been previously mentioned, has much to commend it, in increasing the succulence of the harder, drier parts of the leaf and stalk.

The mixing of the various feeds that make up the concentrate mixture is a valuable labor and time saving operation, and enables the feeder to serve out rations that are uniform in composition from day to day.

The soaking or slopping of feeds adds usually no value to the digestibility or feeding value thereof. In the case of dried beet pulp, or malt sprouts, which swell enormously in the water, soaking before feeding will help to avoid digestive troubles. In the case of a sick cow a bran mash of warm slop is often of value, but beyond these instances the soaking of feed is a waste of time.

The cooking of feed, likewise, has no value in a dairy stable, unless it be the boiling of flaxseed for calf feeding.

CHAPTER VIII

THE MILKING HERD—CARE AND MANAGEMENT

THE MILKING HERD IN SUMMER—IN WINTER—THE COW AT CALVING TIME — MILKING — CLEANING AND GROOMING.

THE MILKING HERD IN SUMMER

CLIMATIC conditions in Canada cause a sharp division in method between the summer and winter management of our live stock. Our seasons are such that there are, roughly speaking, five months in which it is possible for animals to gather their own food and seven months in which it is necessary to supply them with sustenance from storage and provide them with a reasonable amount of shelter. Generally speaking, the farms of Eastern Canada have sufficient land to enable the live stock to sustain themselves during the five months of pasturage, but the season during this whole period is not by any means ideal to provide sufficient high quality pasturage for the fullest returns from the milking herd.

Taking into consideration the great efficiency of dairy cows in turning rough farm products into a highly palatable human food, and the serious break in the pasturage season, caused by the drought of July and August, the question of the economy of feeding productive dairy cows the year round is sometimes asked. Without doubt such method would economize on land, and would enable the highest standard of production of milk. In this connection experimental work done by the Guelph College, in 1915 and 1916, is illuminating. Fifteen high producing cows were fed in the stable during June, July, August and September, under the same conditions as obtained in the winter. During the same months, thirty-two cows of only average ability were pastured with some grain in addition. In the case of the stabled cow the feed was charged at slightly less than the market price for that grown on the farm and actual market price for that purchased. In the case of pastured cows, the actual cost of pasture, which included rent of land, seed, temporary fencing, and labor of man, horse and machinery in seeding pasture which was partly spring sown and annual pasture, was charged. It is worthy of note that both groups of cows averaged the same number of days from freshening time to the beginning of the test, so that the factor of length of lactation period was eliminated. The returns from each group are seen in the following table:

Group	Lbs. Milk in 4 months	Daily average per cow.	Lbs. fat in 4 months	Daily average per cow	Value of grain	Value of roughage	Value of pasture	Total cost of Feed	Feed cost of 100 lbs. milk	Cost of 1 lb. fat.
15 Cows Stabled	56296	30.8	2193	1.2	$187.85	$298.36	......	$486.21	86c	22c
32 Cows Pastured	81650	20.9	3372	.86	178.11	.....	190.17	368.28	45c	11c

It is therefore quite apparent that from the standpoint of feed costs alone, it is more economical to pasture cows in summer than to feed in the stable. If labor had been also taken into account, the results would have been much more marked in favor of the pastured cows.

During the past two decades the best principles of winter stock feeding have become well recognized, and the practices thereof, have undergone great improvement. Such is not the case with the summer feeding which is, in general, in about the same situation as it was twenty-five years ago. This condition is due first to the general lack of available labor at this season, and second, to lack of realization of the importance of the two scanty months of July and August in their relation to the more plenteous pasture periods, both before and after, and in their relation to the economy of the whole season's feeding operations. Any solution, therefore, leading to the betterment of summer feeding conditions must take cognizance of those two most important factors, and, also, to a limited extent, the value and necessity of economizing in tillable land in some instances where high priced land is being farmed.

To dwell at length on the lack of available labor for live stock purposes during the harvesting season is unnecessary here. The fact is painfully evident, especially during the present crisis in agricultural production. Sufficient is it to say that during July and August farm labor is worth, on its production basis, from two to four times as much as at any other time of the year. At ordinary values for labor the direct profits on live stock products are small enough now. A solution of the question, therefore, demands the conservation of manual labor at this time, even at the expense of some other commodity. This means that the animal must gather most of its own feed and scatter its own manure, though it may use a little more land, a commodity still comparatively cheap and plentiful in most Canadian communities.

It is in consideration of the second factor that the weakness of the ordinary pasture system is disclosed. Most farms have a plentiful supply of pasture for the period ending the 25th of June, and again during the period beginning August 20th, and extending until the end of the pasture season. Particularly, is this so, as the usual practice is to pasture the second growth of meadows and the fall rains regenerate the natural pasture. Between the two periods of plenty is the critical time of the year in live stock production. The natural pasture crops inevitably dry up, even good clover pastures do likewise because the red clover plant is the first of all our cultivated plants to feel the effect of heat and drought. This is plainly seen in those years where there is a wet month of May followed by a dry June when, in spite of the good start, the clover crop is light in the fields to be cut for hay. In clover pasture the effect is worse, because the clover is not sufficiently fine in its growth to form a mat to shade the ground. At the beginning of July the milk flow and the growth of animals are usually at their highest point. If they are allowed to fall off abnormally, as they usually do under ordinary pasture conditions, a direct heavy loss is occasioned at once, and worse still, no matter how abundant feed may later become the normal production is never again attained that year, so the loss is really a cumulative one. The writer feels confident in the assertion that the usual falling off in milk flow alone, during the one month of July, of dry, unsupplemented ordinary pastures, causes, on the average a loss of 30 per cent. in the year's milk yield.

For those farmers so situated that their land is expensive and farms are small, carrying a large stock, a system of summer feeding that economizes on land is to be recommended. For such, a system of soiling is useful. This consists of sowing a number of crops that will provide a succession of green fodder to be cut and fed to the cattle during the dry season. The best crops for this purpose are one and a half bushel oats, one-half bushel peas, to the acre, sown in two or three patches about two weeks apart, then a patch of millet or Hungarian grass, or on good warm soil a patch of sorghum or sugar cane, and some early maturing flint corn for early fall feed. The total acreage devoted to these crops should provide at least one-half acre to each head of cows to be fed and of this acreage half could be devoted to the peas and oats. To supplement this green feed, red clover can be used before the first cutting of peas and oats, and the second crop of clover will also be found to fill in a week or two of August. This method will be found to provide enough feed to supplement the pasture and keep up the milk flow, but as is quite evident, will require much labor to cut and haul this feed which makes the system inapplicable to most farms.

A more economical method as far as labor is concerned, is the feeding of silage in summer, which has the advantage of convenience in feeding as compared with soiling. When it is borne in mind that a ton of silage will give a cow thirty pounds a day for two months, it is easy to estimate the additional acreage necessary to provide enough for the herd for the period of summer shortage. The ideal method of handling is to provide a small silo for summer feeding, as silage spoils least on top of a small silo during the warm weather, but if this is not practicable, the additional acreage of corn can be grown and the excess filled into the silo in the late fall after the silo is partly fed out. If the corn has been well shocked the late filling will make excellent feeding during the winter and there will be good silage left in the bottom for summer use. This method also involves considerable labor, not only in feeding but also in the extra cost of cultivating and storing the extra corn.

These two systems just outlined, while valuable in many cases, are, on account of the labor involved, not applicable to most farms, particularly under present conditions. A betterment of pasture conditions seems the most generally useful advice now. A study of the question of pasture for dry weather demonstrates that the essentials are, (first) a thick, fast growing mat on the ground, (second) a crop that will spring up readily after being eaten off, and, (third) a crop whose growth of leaf and stalk is least injured by summer drought and the trampling of hoofs. The first essential can be provided by thick sowing of any crop that is leafy in its growth, the second essential by those crops that, having a quick habit of growth have no early growth of a thick main stalk, but are leafy from the ground up, the third essential is provided by those crops that once having a good start are not seriously affected by heat or dry weather until the seed forming period begins. An examination of the different farm crops discloses that the three spring grown cereals, wheat, oats and barley, come the nearest to fulfilling the three essentials just mentioned. In addition the composition of the increasing growth of these plants is much similar to that of early starting natural grasses.

Keeping all the above factors in view, the Farm Department at the Ontario Agricultural College, recommends the following pasture mixture, that has given exceptionally good results during the past two seasons. This mixture consists of one bushel each of wheat, oats and barley, and seven pounds of red clover, per acre. This mixture is sown immediately after the spring grain seeding is finished, which is about May 15th or a little later. In about a month this thick mixture is usually about six to seven inches high, at which time the cattle are turned on to the pasture. On being eaten off, the plants immediately commence a rapid and thicker growth. To such an extent is this true that if the plants are not allowed to head out the growth will continue well on into August, or early September. It is also well established that red clover will make a more certain catch when seeded with a pasture mixture than in any other way, for the reason that the young plant is not too much shaded and the trampling in dry weather keeps the soil tightly compacted with a slight mulch of dry earth on top.

During the season of 1915, seventy-five head of cattle, all over one year old, were maintained on twenty-seven acres of this annual pasture and thirty-eight acres of third year sod, sixty-five acres in all, from first turning out in May until August 20th when about thirty-five head were removed to some second growth clover. During 1916, a very dry and hot summer, seventy-seven head were pastured on thirty-four acres of this annual pasture and thirty-six acres of permanent pasture, from the last of May to August 25th, without feeding one pound of silage or other coarse food, and the milk flow of dairy cattle and growth of beef cattle and young stock were kept at normal during that time. On the last mentioned date about half the cattle were removed to some second growth clover, but the annual and permanent pasture carried at least half the stock the balance of the season.

From the results herein obtained, there can be no hesitation in recommending this pasture mixture to better live stock feeding conditions in summer, to any farmer. The seed itself is found on every farm. On nearly every farm, some tillable land is nearly always used for pasture that will give much better returns under this mixture than as grass or clover pasture, and, moreover, a good catch of clover is assured for hay the following year.

In a previous chapter the possibilities of sweet clover as a pasture crop have been briefly discussed. This crop differs from ordinary red clover in that it is much deeper rooted and therefore it suffers less from drought. Moreover, its habit of growth is a stiff central staff from which branch out smaller branches carrying abundant leafy foliage. As these leaves and smaller branches are cropped off new growth immediately takes their place. As by this time the main stalks are fairly dry and woody they are not usually eaten off nor do they trample down readily. They therefore, go on producing leaves and tender branches to replace those eaten off, and this habit provides an extraordinary amount of herbage in very dry seasons. The use of this crop as a pasture for all kinds of live stock is spreading rapidly, and although there is not much experimental data on this subject, much actual farm practice during the past three years has firmly established its value as a pasture crop.

Permanent Pastures:—We have in this country a large area of rough land and steep hillsides, all unfit for cultivation, but that produce a large amount of fine natural pasture ideal for milk production. This is the best use to which this land can be put. It is evident, however, that good tillable land will not give the best returns if left to grow natural grasses, because much greater growth can be obtained from such land by growing mixtures of grasses and clovers that give a stronger and more vigorous growth throughout the summer season than do the natural grasses. Good mixtures for this purpose must contain some clovers which give a high protein content to the pasturage and also those grasses that give quick early growth in spring and that last well through dry weather. Where land has grown alfalfa, this seed can be used to good advantage, as it will stand pasturing by cattle reasonably well. Red Clover and alsike, on account of their general use and ease of catch, should also form part of a permanent pasture mixture, and white clover, if seed can be procured, lasts for a long time under pasturage. A good permanent pasture mixture would consist of:

4	lbs	red clover
2	"	alsike
2	"	alfalfa or white clover
2	"	orchard grass
2	"	tall oat grass
2	"	meadow foxtail
2	"	Kentucky blue grass
3	"	timothy

This amount would seed one acre. The best combination of pasturage for any stock farm would consist of two-thirds of an acre of good permanent pasture, and two-thirds of an acre of the annual pasture previously mentioned or an equal amount of sweet clover, for each head of cattle one year old or over. This amount, with the use of second growth on meadows for pasture, will supply the farmer with sufficient pasture without necessitating the use of soiling crops or even silage during any ordinary summer.

Grain Feeding on Pasture:—It is evident to all dairymen that cows reach their maximum milk flow during the late spring and early summer, because the fresh green grass is of the ideal composition for milk production, and is usually plentiful enough to supply all the wants of the animal with the minimum amount of labour and time in grazing. Under these conditions, the addition of grain will not stimulate the flow of milk to any profitable extent. While the change from stabling to pasturing is being made, however, the feeding of a small amount of grain will be found profitable. This tends to create a less violent change from dry feed to the watery immature grass, of which it is rather difficult for the cow to consume enough bulk to properly supply the necessary dry matter to fill all her needs. In addition to grain, a small amount of silage will often be acceptable at this time, but it is difficult to get the herd to eat any dry roughage unless it be extra good clover or alfalfa hay. As long as the pasture is plentiful and green the feeding of grain will not be found to return immediate profit with cows of ordinary capacity. It will help, however, to build up the system to better withstand the shortage later on, and for this reason the feeding to cows of better than ordinary productiveness of a small concentrate allowance is to be recommended as soon as pastures commence to show the least indication of failing. During the heat of summer when flies are bad, the feeding of grain will be a great help in carrying the cows through these adverse conditions with the minimum amount of shrinkage in milk flow. For this ration, bran, cottonseed meal, oil meal, and oats or barley, are the best concentrates, as the three former are usually then at their lowest price during the year. From one to two pounds per day of a mixture is sufficient feed while pastures are reasonably good, with a maximum of four pounds in hottest weather, which would be all that could be fed profitably. If the milk flow continues to decrease abnormally, it is a sure indication that the supply of roughage or pasture is short. This can be improved by more pasture, soiling crops, or silage, rather than by increased grain feeding.

Water in Summer:—A plentiful supply of clean fresh water is an absolute necessity in getting good results from the herd in summer. If a creek or spring is not available in the pasture, the herd will have to be supplied from a well. A well in the pasture with a windmill and pump is found to give good satisfaction if the machinery is regularly looked after and oiled. Where it is necessary to water near the barn the cows should be allowed to drink their fill twice a day at the very least, and in hot weather three times if it is at all practicable to get them to the water. Where a water system is installed in the stable the cows can drink with most comfort and least annoyance when they are put in to milk.

Salt:—While on green pasture cows will consume a great quantity of salt. This is best fed by putting a small handful in the manger once a day while the cows are inside. If the pasture is close to the buildings, where it can be renewed often, an old trough will do nicely for salting, and the cows can help themselves at will.

Shade:—In summer, shade is almost an absolute necessity in our climate. The cow becomes heated from pasturing in the open and pestered to more or less extent by the flies. When she wishes to rest and chew her cud she should have a comfortable place to do so, where she can cool off and where flies will not bother her so much. She will show her appreciation of this comfort by a good response at the pail. Pasture should always, therefore, be arranged with a view of providing shade.

THE MILKING HERD IN WINTER

Weather conditions usually compel a gradual change from pasturing to stable conditions. While the dairyman wishes to make the most of the pasture that is usually plentiful in the fall, to leave the cows out in the cold and rainy weather, especially at night, is not profitable. This causes a serious shrinkage in the milk flow that would be avoided by keeping the cows in the stable and feeding some hay, silage, and grain. When the nights become frosty and cold it is advisable to keep the milking cows in the stable all night. Even if feed is plentiful in the pasture the cold nights cause a shrinkage in the milk flow that can in this way be avoided. In this case it may be unnecessary to feed much in the stable, the comfort of the cows being the main purpose in keeping them stabled. While the herd is being stabled at night and pastured by day, it is difficult to keep the animals clean. To avoid this as much as possible some bedding is necessary. In addition, cows should be fed, milked, and turned out as early in the morning as possible, because it is when they lie down the second time that they become badly fouled.

Winter Feeding:—Experienced dairymen have often noticed the enormous capacity for food that all animals possess when first stabled in the fall. This is a natural instinct inherited from the days of the wild cattle, when it was necessary that all animals accumulate as large a store of body fat as possible to tide them over the shortage of feed and rigorous climate of winter, and in the case of the breeding cow to put her in the best possible condition for maternity in the spring. As cows that have been milked well throughout the summer are never in very high condition in the fall liberal feeding is required at this time to maintain at normal the milk flow, and also to provide the food necessary to improve the bodily condition that the above mentioned instinct demands. Good dairymen find it profitable to provide well for both the above conditions, realizing that until she has reached good condition the cow is likely, if not well fed, to use the most of her feed to attain that object rather than to produce milk. Moreover, when she reaches good condition her maintenance cost will be less for the balance of the winter than if she be low in flesh. It is well, therefore, to feed most liberally, with the best quality of feed, for the first two months of the stabling period, and if economy becomes necessary the herd of all ages is naturally able to stand it better towards spring. This applies particularly to the best use of hay and straw. It has been the writer's experience that it is better to feed good hay in the fall and early winter, and when the herd is in good condition they will eat straw and poorer hay with more relish and therefore, with better results. Where nearly all the cows calve in spring, before pasture starts, it is wise to retain some of the best hay for use when the cows freshen. But it will always be found profitable to feed well with some of the best feed on hand early in the stabling period.

Feeding Two or Three Times a Day:—It has often been noticed that a cow on pasture likes to be reasonably full before she quits eating and lies down to chew the cud. She desires also to have a considerable period of time to perform this necessary operation. It is advisable under winter conditions to follow as nearly as possible the method the cow herself would employ if left to her own devices. In the usual dairy herd this points to the practicability of feeding only twice a day. This method gives the cattle a good spell to lie down quietly and chew the cud during the middle of the day, which they would not get in the short winter day if fed at noon. In addition, while labor is scarce, a longer time during the middle of the day for other work on the farm will always be found advantageous. In pure-bred herds, where cows are being tested for official records, and particularly where milking is done more than twice a day, it is better to feed three times or even oftener, as a greater consumption of feed can be induced in this way.

Order of Feeding:—The order in which the different parts of the ration are fed in the day, depends much on the amounts of the various classes of feeds being fed. Where a large amount of silage and roots and only a moderate amount of good hay are used, the best plan is to divide the succulent feeds into two feeds, morning and evening, and feed the hay in one feed, preferably right after the silage and roots in the morning. At this time it is more convenient to replace in the mangers the hay that inevitably is thrown out while the cows are eating. The meal ration is best fed on top of the silage, at both feeds. If straw, or poor hay, is being fed, these are best used at the last feed in the day so that the cows have a better chance to work them over during the long night period.

Regularity in Feeding:—Owing to her highly nervous organization the dairy cow reacts very quickly to any sudden change in the daily routine of stable work, and such changes invariably cause a decrease in the milk flow for that and succeeding days. Therefore, regularity in all feeding, tending, and milking operations, is one of the most important features of successful stable management. Even though the herd may have the ability for high production and there be fed an abundance of the right kind of food, a herd will not produce profitably without regular care and attendance. The dairyman who has the best possible combination of these three factors is always the most successful.

THE COW AT CALVING TIME.

The condition of the cow at and after calving has the greatest influence on the success of her ensuing lactation period. If she has had at least six weeks' rest since drying up, and has gained up in weight so that she is carrying considerable fat, she has stored up considerable energy both muscular and nervous that will be a much needed reserve to draw on during the strain of calving, and during the exacting continuous nervous strain of milking day after day. It has also been well established that the more fat a cow accumulates in her body before calving the higher will be the percentage of butter fat in the milk for some weeks after freshening. So the expense of feeding a cow well before calving not only creates a much needed reserve of energy, but is directly returned in the product immediately after calving.

In early summer, if a cow is dry, all she needs is the good pasture found at that season. If pasture is scarce and dry, she should have as good supplementary feed as the milking cows, though grain feeding is not necessary. In winter, give a liberal supply of good roughage such as the milking cows are getting and laxative concentrates, such as two or three pounds per day of a mixture of any of the following: bran, oats, oil meal, brewers' grains, cornmeal, or gluten feed, care being taken that bran or oil meal be included in the mixture. The feeding of a few roots is advisable at this time. As calving time approaches the most important consideration is to keep the bowels lax. Practically all the usual troubles that follow calving can be traced to constipation at this time, milk fever, chills, loss of appetite, and caked udder among them. If bran and oil meal, roots or silage are found in the ration there will usually be little danger in this respect. It is usually perfectly safe to continue the feeding of bran and oil meal right up to calving and even right after, unless there be undue inflammation of the udder. If the cow is constipated, or even if the manure is hard and dry, a dose of one and one-half pounds of salts and one ounce of ginger should be given before calving, and repeated, if constipation is still evident, twenty-four hours after calving. In this connection, a drink of the cow's first milk is a valuable laxative. This old homely method is to be advised in any case, even if the cow is in the best of calving condition. To have the cow calve in a box stall, by herself, is to be preferred, unless the box stall be much colder than her usual place in the stable, as a chill is to be avoided at this time. If the cow's udder is hard and inflamed, it is a good practice to leave the calf with the cow for a day or two; otherwise the sooner the calf is taken away after it is dry the less the cow will miss it and the easier it will be taught to drink. If the calf is taken away immediately after birth, it should be briskly rubbed dry with straw, or some old rags or sacks. The cow should not be milked out clean for the first four days; rather she should be partly milked out three or four times a day at first. It is popularly supposed that milking out dry at this time brings on the nervous paralytic affection known as milk fever. Should this disease appear, as it sometimes will, in spite of all precautions, the simple effective remedy is to pump each quarter of the udder full of air, and tie the teats to prevent the air escaping. The equipment necessary for milk fever treatment should be in the hands of every stockman. If the afterbirth is retained, it should be removed by a competent person within forty-eight hours after calving. Although this is a simple operation, it should be done carefully and thoroughly, to prevent bleeding and to entirely remove all particles from the extreme forward parts of the uterus. After the afterbirth is all removed, the uterus should be flushed out with an antiseptic solution. For this purpose a solution of boracic acid or oxalic acid is to be preferred to carbolic acid or other coal tar products, which are harsh in their action and cause undue straining. After three or four days the cow can be reduced to the normal milking periods, and her feed gradually increased until at ten days after calving she can be safely put on the maximum ration for the milk being produced. It is well, however, not to feed any barley, which is heating, or cottonseed meal, which is constipating, till at least two weeks after calving.

Milking

Milking should be done regularly, at the same time each day, and periods between morning and evening milkings should be as nearly of even length as is possible. The cows should also be milked quickly and all the milk drawn at each milking. Slow milking induces in the cows a tendency to hold up their milk, so that it is difficult to get them milked cleanly. If the milk is not all drawn at each milking, the cows are not properly stimulated to produce their maximum and they dry off more quickly. The quality of the product depends largely on the thoroughness and cleanliness of the milking operation. The cows should be free from manure, particles of bedding and loose hairs. This can be accomplished only by keeping the cows brushed every day, and by brushing again the hind quarters just before milking. Wiping the flanks and udder with a damp cloth, just before starting to milk, will cause particles and hair to adhere to the skin and prevent them dropping into the pail. The cleanliness of the cows can be greatly improved by clipping the hindquarters, flank and udder, at the beginning of the stabling. Milking should always be done with dry hands. Wet hand milking is a most filthy operation, as it causes dirt from the teats, in solution, to drop into the milk from which it is impossible to strain it. Cows with sore teats should be left till the last, to avoid spreading the contagion to other cows. If it is too painful to milk sore teats with dry hands, a little vaseline on the teats is to be preferred to wet hand milking, while the vaseline will have a beneficial action. A narrow mouthed pail will catch less dirt than the ordinary milk pail, and after a little practice will be found as easy to use.

The milking of heifers should have particular attention, as the habits of the cow's whole life are determined in the first lactation period. If the heifer is restive, it is better to spend a little time and use a little patience and kindness and milk her without tying her feet, which should be done only as a last resort. If it becomes necessary to tie her feet she will always be a risky cow to milk, and after every calving, thereafter, she will need to be tied, when a little more determination and patience at the first would have made her a quiet cow.

It is not always practicable, and it is not essential, that milkings be twelve hours apart, to get the maximum results from the ordinary dairy herd. Cows milked at ten and fourteen hour intervals will produce satisfactorily, if the work is done regularly at the stated hours. It is well to remember that the milk after the long interval is invariably lower in butter fat test than that after the short interval. This factor must be taken into account by men supplying milk to the retail trade, where uniformity in the quality of the milk is an important consideration. Cows in official record work, whether milked two, three or four times daily, should always be regularly milked at equal intervals, in order to keep the fat test of all milkings as near normal as possible. The point at which it is profitable to milk more than twice a day is one that cannot be definitely ascertained. With a grade herd it is doubtful if it would pay to milk more than twice; a little extra milk and some additional butter fat may be obtained by milking oftener, but unquestionably these would not pay for the extra labor involved, especially in the spring and summer seasons. With pure-bred cows, the small gain in milk and fat added to an already good production would naturally increase the value of the record more than the actual value of the excess product. With such cows, giving upwards of fifty pounds per day, thrice a day milking might prove profitable, and if sixty-five pounds per day is reached it becomes necessary to do so. Very few cows have given more than seventy-five pounds per day on twice a day milking, and it appears physically impossible for a cow to give more than eighty pounds under this method. At the same time where regularity in care and milking and an abundant supply of suitable feed is supplied, the right kind of cows will make very large and creditable records from twice a day milking, as the following records from the Ontario Agricultural College dairy herd will show:

Name of cow	Breed	Age	Lbs. Milk in 1 year	Lbs. Fat in 1 year
Young Springwood	Holstein	5	20,110	821
Blackie	Holstein-Grade	13	17,019	640
Molly Rue Rattler	Holstein	3	16,975	640
Molly Rue	Holstein	6	16,466	602
Margaret Cornucopia	Holstein	10	14,978	554
Iford Waterloo Baroness	Shorthorn	5	13,410	502
Fairy Duchess	Shorthorn	4	9,573	384
Flora Hope	Shorthorn	2	7,773	318
O.A.C. Minnie	Ayrshire	8	12,531	477
O.A.C. Glennie	Ayrshire	8	9,384	401

No doubt each of these cows would have made larger records had they been milked three or four times per day with the same care and attention which they received. These records give an indication of the possibilities of twice-a-day milking in official record work, and help to remove the idea from the minds of beginners in this work that it is useless to attempt it unless it is possible to so arrange the work of the farm as to milk oftener.

THE MILKING MACHINE

The statement that the milking machine has now become a practical proposition can now be made with considerable confidence. Practically all the standard makes of machines sold in this

Dominion, the cheaper ones as well as the more expensive, are giving good satisfaction in the hands of a great many dairymen. There are, however, many instances where each make has not been successful. Analysis of the results that have been obtained by a great many dairymen show that success or failure depends upon the ability of the operator, and not on the make of the machine. All machines are somewhat complicated and somewhat delicate of adjustment, so that to be successful the operator must exercise some mechanical ability, and strict care and attention to the needs of individual cows. Without these the milking machine has always proved a failure. It can hardly be said that the machine will get as much milk from the cows as good hand milking, but, properly handled, it will give better results than the average hand milking, and there is no doubt of its being a great economizer of labor and time. The machine has its place on the farms of dairymen who milk more than ten cows, it being doubtful economy to invest so much money for a smaller herd. It may also be doubtful economy to instal the machine in a herd of pure breds where much official test work, involving milking three or more times per day, is being done.

Regarding the quality of the milk from the machine, it is safe to say that where the machine is kept scrupulously clean it will produce nearly as much clean milk as the most careful hand milking.

Where the machine is not kept clean it produces the most impure milk imaginable, being full of the bacteria that cause the most destruction to the keeping quality of the product. These bacteria, found in the unclean parts of the machine, are more harmful even than many of those which fall into the pail during hand milking. Mechanical ability, incessant care and cleanliness only, can make a success of the milking machine.

Cleaning and Grooming

Apart from appearances, brushing and grooming have a direct value and influence on the production and thrift of the herd. Brushing and grooming, by removing dust and dead hairs, contribute much to the comfort of the cow which, in a highly organized animal, is an important financial advantage. Keeping the skin and hair in a clean, active condition also helps any animal in making better quality of milk, which adds to its value greatly. If cows are kept free from manure, the work of grooming a herd into clean condition every day is very small. With a stiff corn brush one man can sufficiently groom at least two cows a minute. If a currycomb is necessary, an old horse currycomb, on which points are slightly worn down, is more satisfactory, not being as severe on the cow as a new comb.

The proper use of bedding contributes much to the ease of keeping cows clean. In general, short or cut straw is preferable to long straw, which tends to mat under the bellies, to be kicked into the gutter, leaving bare of bedding the place under the cows' hind feet, and therefore a smaller amount is necessary to keep the cows clean. Again, if cows are tended regularly, they acquire fixed habits as to lying down at certain times of the day, which gives an opportunity to scatter the bedding just before they lie down. This rarely takes more than a minute in any stable, and is time well spent in saving labor and grooming, and in adding to the appearance of the herd. Some men make a practice of tying the end of the switch of a cow's tail with a long string that reaches from the ceiling to about a foot above the bottom of the gutter. This keeps the tail out of the liquid of the gutter when the cow lies down, and prevents the soiling of the cow's sides when she switches her tail on standing up. This scheme, of course, can only be used in winter, and where cows are turned out occasionally.

The proper length of stall for each animal contributes much to its cleanliness. This will be dealt with more fully in the discussion of stables.

Watering:—Whether or not cows in the stable should have a supply of water within reach at all times, is not really important, provided milking cows can get their fill comfortably twice a day and the rest of the herd once a day at least. It is necessary that the water be abundant and pure, and that the cattle can get it conveniently and with comfort. Therefore, even if it is the common practice to turn cows out of the stable every day, the water supply should be provided in the stable. The cheapest and most simple installation is the use of a continuous concrete manger, which may be used both for feeding and watering. This avoids the expense of piping that is necessary with a water bowl system and that occasionally gives trouble from freezing in severely cold weather. A drain pipe from the manger is necessary with this system to let out the excess water, but in most stables this expense is negligible. Water turned into the manger twice a day is often enough for all practical purposes, because under natural conditions a cow requires a fill of water no oftener than this. There is some little time required in sweeping the manger before watering, but even this is negligible as the bottom of the manger is always smooth, and particles of feed do not adhere to it. A good water bucket system once installed, of course, does not require much attention, except to see that the piping is not allowed to clog up or freeze. Comparing a fountain system that feeds from overhead with one that fills the bowls by gravity from a tank with ball float and valve, each system has its advantage. The former is less liable to be clogged up, but if the valves in any bowl get stuck when open the stable will be flooded. The gravity system is slower in its operation, but there is less liability of flooding at the bowls. In installing the latter system each bowl should have a check valve that will prevent water once entering the bowl from returning to the pipes, carrying particles of feed and saliva that may cause a clog up or contamination of the water supply.

If water is convenient in the yard outside, watering in a trough is satisfactory except in cold or stormy weather, at which time cows will not drink their full supply. This is an important consideration with milking cows. Driving cattle long distances to water, though sometimes necessary, is not good practice from the standpoint of profitable returns.

Exercise:—Turning cattle out on fine days will give them some valuable exercise, but leaving them out in the cold causes a loss in heat that can only be made up by additional feed. Cattle in a well ventilated stable with an inside water supply will come through the winter in good shape without much outside exercise. Cows in heavy flow of milk are hard worked anyway and the value of outside exercise is problematical. An animal that is going sore on its feet should be turned out regularly.

Chapter IX

THE CALF—THE HEIFER—THE BULL

The Calf

THE sure and safest method of improving the milking quality of a herd of cows is to raise the heifer calves from the best cows in the milking herd. It may not always be good practice to raise the heifer that is her dam's first calf; the dam may not turn out a profitable cow and by the time this is found out a certain amount of expense has been incurred in raising a calf that would not otherwise be kept. It is safer to select calves from proven cows, and even then there are many instances that cannot be explained, of inferior heifers from heavy milking stock on both sides.

After birth, the calf should be removed from the sight of the cow when less than three days old. Some good dairymen advocate taking them away at birth, but the calf will get a better and more natural start if allowed to suck at will the first day or two, while the udder of the cow will be benefited, and it is not a serious matter to teach a three-day calf to drink from a pail. The usual well known method of using the fingers to teach a calf to drink from a pail has never yet been improved upon. Different, more or less mechanical contrivances with artificial teats have been contrived, all of which owing to the necessity of washing have been found impracticable and if not kept clean do injury to the digestive organs, through contamination of the milk.

The growth of the calf during the first year will depend much on the start the calf gets the first month. It should, of course, have its mother's milk for the first three or four days. The fresh milk of the newly-calved cow contains that product, colostrum, that is necessary to stimulate the newly-born calf's digestive system into action. At least the calf should have fresh milk till two weeks old, five to six quarts per day being sufficient. If it is desired to change on to skim milk, which is the only really successful method of raising good heifers, the change should be made gradually, substituting every day more and more skim milk for the same amount of fresh. It becomes necessary, of course, to provide in some way the fat a calf must have, but which is lacking in the skim milk. For this purpose flaxseed jelly is best. This is made by simmering a pound of ground flaxseed in 3 quarts of water, or boiling one pound of ground flaxseed in a gallon of water until a thick jelly is formed. When the change is being made from whole milk to skim milk, a tablespoonful of this jelly should be added to the milk, gradually increasing the amount until at one month old a half cupful may be fed at each feed. The Central Experimental Farms recommended the following mixture, to be fed in much the same way:—

One part ground flaxseed.
Two parts fine cornmeal, sifted.
Two parts finely ground oatmeal, sifted.

Boil and allow to stand twelve hours covered. Begin with one-eighth of a pound per day, when the calf is one month old; new milk for the month previous and no solids. Increase the amount per day as the calf grows older, until one-half pound is being fed.

As the calf gets over three weeks old, it will start to nibble at a little hay. Some good clover, or alfalfa, should then be within reach at all times, till three months old. At about the same age it will commence to eat a little grain, and for this purpose there is nothing better than equal parts of bran and oats, (whole oats preferred) fed in addition to the flaxseed or other food in the milk. In feeding calves, it must be remembered that skim milk must be more carefully fed than whole milk. Lacking, as it does, the natural butter fat, an overdose is almost certain to bring on indigestion and scours. If fed cold, when calves are used to warm milk, the same difficulty occurs, Care must also be exercised in keeping the pails clean and sweet. Sour skim milk can be safely fed after the calf is about three months old, if the calf is gradually made accustomed to it and it be fed entirely. Though skim milk is the best feed on which to rear calves, sweet whey can be used if the change is gradually made from milk to whey, and the flaxseed or other jelly added the same as to skim milk. Where neither whey nor milk can be procured, the use of hay tea has been found of help. This is prepared by boiling cut clover or timothy until a strong tea is obtained. This is fed exactly the same as milk. Calves may profitably be kept on skim milk or whey till six or seven months old, and if extra size is desired, it may be kept up till ten months.

The pasturing of calves under six months old is not to be advised. The digestive system of the calf requires feed in more concentrated form than does the older animal. Grass, therefore, has so much bulk in comparison with the nutrients supplied, that the calf's system cannot handle it economically until developed by age. Moreover, the thin skin and fine hair of our dairy calves cannot well stand the blistering effect of the sun and flies when pasturing in the open. The calves will do much better if kept in a dry pen or shed, where they can be conveniently fed. If the pen is darkened during the heat of the day, the flies will not cause much trouble. When, however, they have reached the age of six months, and the worst of the heat is over, and pasture plentiful, calves will do well to be turned out, and exceedingly well if the feeding of milk and a little grain (say one or one-and-a-half pounds each per day) be continued for a month. Calves that have had a run at pasture during the fall months usually get thin, but seem to feed and grow better during the ensuing winter, than if kept stabled the entire first year.

Until the calf is one year old, the ration should be of good quality hay, roots and meal, rather than too bulky, that is containing too much silage or corn fodder. A small amount of silage may be fed the first winter, say six or seven pounds a day at most, to add variety to the ration. Clover or alfalfa hay should form the bulk of the ration, and the grain ration need not be large, but should consist largely of bran, oats, and oil meal, all of which are suitable for young and growing animals. If dehorning is practised, and this operation is to be advised in at least all grade herds, it can be most easily done to the calf. The operation consists in application of moist caustic potash to the small horn or button, about the time it comes through the skin. Care must be observed to keep the potash from contact with the hands and from the eyes of the calf.

THE HEIFER

Feeds and Care:—In spring all calves over seven months old can be turned out to grass which is plentiful, and is all the feed required till fall. Beyond seeing that there is plenty of pasture, shade and water, and salt twice a week, no other care is needed till late in the fall, as heifers may be safely left out as long as there is pasturage to fill them up. When brought into the stable the food should be plentiful, but bulky in its nature, in order to develop a large and efficient digestive system. Silage may be fed liberally; oat straw and a moderate amount of hay and roots, fed in comfortable quarters, will supply all the necessities for good growth and development. If a heifer is due to calve in the spring she should have a little grain added to her ration. For this purpose, two or three pounds per day of the grain mixture being fed to the milking herd will do. If the bulky part of the ration is not of very good quality, a little grain mixture can be fed to advantage, especially during the early winter.

Time To Breed:—It is usually not good practice to breed a dairy heifer till she is at least twenty months old. If she is of average size for her breed, should she be bred earlier she is not likely to make both her normal growth and her best yield of milk during her first lactation. She will become stunted in her growth, and always be a small cow on that account. If she be extra large, the heifer may safely be bred to calve shortly after she is twenty-four months old. During the period a heifer is carrying her first calf, she requires occasional handling in order that she may make as little trouble as possible when first commencing to milk. Kind treatment at this time will be well repaid during her future milking life.

THE HERD BULL

The entire care of a dairy bull must be with the view of keeping his vigor and getting power at their highest point. In addition to the proper kind and amount of feed, he must have sufficient exercise in order that his system may be kept active and vigorous. The dairy bull has much the same digestive capacity as a cow, so that when he reaches maturity he has the digestive power to lay on fat readily. This excess fat usually slows him up, makes him heavy, and he loses his procreative powers unless he is compelled to take enough exercise to keep down this condition. The feed of the bull, like that of the cow, needs to be of a bulky character, but should not be too coarse and watery as, for instance, a heavy silage ration that would develop too much middle, which in a bull injures his vitality, making him slow and clumsy. Clover hay should form the bulk of a bull's ration, in addition to a small amount of roots, silage and straw. With this kind of feed, a bull may require very little grain, except when he is doing heavy service. At such times, three or four pounds per day of bran, oats and oil meal would prove ample. If clover or alfalfa hay could not be procured, timothy or blue grass hay will give good results, but a little more concentrates, preferably bran, will have to be fed. As a bull has a large body to maintain, he requires considerable total feed. The following rations would be suitable for a bull 1,500 to 2,000 pounds:

Ration 1.—	Clover Hay	20 to 25 lbs. per day.
	Oat Straw	5 lbs. per day.
	Roots	20 lbs. per day.
	Silage	10 lbs. per day.
	Grain Mixture	2 to 4 lbs. per day.

In summer an equal weight of cut grass, or other soiling crops, could take the place of roots and silage.

Ration 2.—	Timothy Hay	15 lbs. per day.
	Corn Fodder	10 lbs. per day.
	Roots	30 lbs. per day.
	Grain Mixture	4 lbs. per day.

For a young and growing bull, usually active at that age, more liberal feeding can be safely done as growth has to be provided for. Even at that age, the roughage should consist largely of hay and straw and roots, rather than silage.

The handling of a bull often causes serious consideration, especially after he becomes old enough to do physical harm. No bull, no matter how quiet, should be trusted, as he may turn ugly at a second's notice from no apparent cause. It is usually the quiet bull that hurts someone as the cross bull seldom gets the opportunity. A bull is usually quieter if kept stalled where he can see the cows. He should have a box stall to himself where he has considerable room to move around. As a rule, however, when he gets older it becomes difficult to catch him in the stall. To avoid this, he should be tied with a light rope long enough to reach twice from the ceiling to the floor. One end is snapped to the ring in the nose, the other is passed through a pulley at the ceiling, near the door of the stall, and a weight of a couple of pounds fastened thereon. This weight is just sufficient to keep the rope tight and prevent a loop of the rope at the bull's nose from reaching the floor to be stepped on, while not heavy enough to inconvenience the animal in moving about the stall. At the same time the weighted end of the rope can be grasped on opening the door, to which the bull can be drawn without entering the stall. For exercise, the bull should be turned out in the yard every fine day. The more exercise he gets, the less vicious he will be. If he is difficult to catch in the yard, he can be tied by a rope to a pulley block, running on a rope or wire cable stretched overhead between two posts in the yard, with just enough slack in the rope so that he cannot get his foot through it. If one or both of the posts are in the yard, a stop must be put on the cable to prevent him from walking around the post and tangling himself up. This is one of the best methods of handling a vicious bull, as he is always under control. If not too highly fed, most bulls of the dairy breed are active enough to take sufficient exercise. A bull over one year old should never be led out without a strong staff. If it is necessary to lead a cross bull, blindfolding him with leather or a folded sack will usually make him quite safe to handle. Dairy bulls, never allowed to get in high flesh and with sufficient exercise, have been known to remain active for service till ten years old or over.

CHAPTER X

COMMON AILMENTS AND DISEASES

LIKE all living creatures, the dairy animal is not always in perfect health. Since dairy cattle now live under rather artificial conditions they are no doubt afflicted by more ailments than if living under entirely natural conditions. The old saying "prevention is better than cure", admits of no more proper application than in the dairy business. Therefore, the aim of all dairymen should be to give that care and attention that will ward off disease, rather than to depend on his own skill or that of his veterinarian to avoid serious loss from this source. Though the most stringent care cannot always prevent diseases from creeping in, the following of the simple rules of ventilation and cleanliness, the supply of abundance of good food, admission of sunlight and periodic disinfection of stables, will prevent most of the losses that occur in dairy stables from disease.

A discussion of some of the commoner afflictions of cattle that yield to treatment by the farmer himself, together with causes, prevention and cure, here follows:

Abortion:—This disease is of two distinct kinds, mechanical or accidental abortion, caused by a fall, a blow, or a hook from another cow, and contagious abortion, due to the presence of a germ in the genital organs of the pregnant cow. The first kind only occasionally happens, and can be avoided only by care in handling the cows to avoid accidents of this kind. The second kind is the scourge of the dairy business. The germ of this disease has extraordinary vitality which enables it to remain active in the system of the cow from one pregnancy to another, and great power of resistance, which enables it to survive medicinal treatment that does not have actual contact with the germ itself. Because the germ lives in the womb, which is tightly closed except for a few days after calving, it is, of course, impossible to bring the germ in direct contact with disinfectants for the greater part of the year. Therefore, there has not yet been found any course of medicinal treatment to which the disease has appreciably yielded.

The disease usually finds its way into the stable through the medium of a purchased cow that is infected, or a bull that has served an affected cow passing on the infection to healthy cows. The most obvious method of prevention is to avoid the introduction into the herd of either males or females from herds that are infected, and to prohibit the service of outside cows by the herd bull. Should the disease once get a foothold in the herd, the spread of the disease to all cows is always very rapid, and even with the strictest treatment will take some years to entirely eradicate. There are the best grounds for belief that a cow may carry the affection and yet not abort, having sufficient resisting power to prevent the disease from operating. It is also believed that when a cow becomes normal, after aborting one or two times, that she still retains in her system that infection, that may be transmitted to other animals. The latest investigation into the disease points to the probability of a heifer calf, born normally from a cow of either of the above kinds, carrying the infection in her system until she herself is of breeding age, when she may abort. The same investigations show that it is possible for a healthy heifer calf to become infected from the milk of an infected cow, and carry the infection until it causes her to abort at the first opportunity. These may explain the lack of success in eradicating the disease that has so far attended the strict methods of isolation, sanitation, and disinfection heretofore practised by many dairymen. This would also partially explain the progress of the disease, through practically all badly infected herds; that is, that the infected cows seem to become immune after two or three years, and that ensuing outbreaks are usually among heifers and purchased cows.

The only methods of handling an infected herd are isolation of aborting, or about to abort, cows from the rest of the herd, disinfection of stalls and gutters about the infected animals, and burning or burying all discharges and bedding from aborted cows. Added to these is the necessity of flushing the vagina and washing of the exterior genitals, tails and thighs, with an antiseptic solution till all discharges cease. The sheath of the bull should be cleansed with an antiseptic after each service. The best disinfectant for internal work is a three per cent. solution of carbolic acid, phenol or chloral naphtholeum or a ten per cent. solution of boracic acid, which has the advantage of not being so harsh as to cause severe straining, which sometimes is the result from the first mentioned disinfectants. For external use and disinfection of stalls and gutters, etc., a solution of carbolic acid, zenoleum or any other coal tar product, double the strength mentioned above, and for use in disinfecting the stables a two per cent. solution of corrosive sublimate will also be found very effective.

One of the frequent results of abortion is temporary loss of the breeding powers of the female. Good feeding and frequent flushing of the vagina, to expedite the healing of the organs after abortion, is the best treatment for this condition.

Bloat:—This ailment is caused usually by a too heavy feed of damp green feed, such as red clover, corn, or rape. The best preventive is to have the animals partially satisfied before turning on to such feeds as the above, or to drive animals out before they have a chance to gorge. In moderate cases a dose of two tablespoons of turpentine in a pint of raw linseed oil will work a speedy recovery. If the case is severe, immediate tapping with a trocar and cannula at a point equi-distant from the hook point, loin edge and last rib on the left side. This should be followed by a dose of turpentine and raw oil mentioned above, and light feeding for three successive days. Tying a short piece of fork or broom handle cross-wise in the animal's mouth has also been found to give quick relief.

Blind Teats:—This trouble arises from different causes but is usually the result of a growth in the milk channel, following an attack of mammitis or garget. It is sometimes caused from a deep wound such as a barb wire cut. Should the trouble commence while the cow is in full milk, little can be done except to milk with a milk tube, kept clean and sterilized, and when the cow goes dry the growth can be partially removed with a teat bistoury. This operation should be performed only by a competent veterinarian.

Bloody Milk:—An injury to one or more quarters of the udder, or an attack of garget, are the usual causes of this ailment. Frequent milking of the affected quarter, and bathing with hot water twice daily, usually effects a cure.

Cow Pox:—This is a common trouble during the spring when cows are first turned out to pasture, and is usually spread from cow to cow by the hands of the milker. The use of zinc oxide, carbolic salve, or even vaseline and sulphur, after each milking, is the best treatment. When the disease first appears, the affected cow should be milked last to avoid spreading the disease to other animals.

Foul in the Foot:—Sometimes from the presence of dirt between the toes, the animal's foot will become swollen and sore. The foot should then be scraped and washed clean with a disinfectant, every day, and the foot kept wrapped in a sack containing a gallon of moist bran.

Garget or Mammitis:—Garget is well known to all dairymen. The natural swelling of the udder at calving time must not be confused with this disease, which may occur at any time in the milking period. Caked udder is another common name for the trouble. The usual cause is a chill due to cold in the udder brought on by draft or by contact of the udder with the cold, damp floor or the ground. If taken at the beginning, a cure is usually effected by keeping the cow in a warm dry place, and dosing her with Epsom salts, or raw oil. Frequent massaging of the quarter, followed by rubbing with sweet oil, castor oil, or lard is to be advised. Should the case become severe, fomentations with hot water three times a day will be necessary. The udder must then be rubbed perfectly dry, and camphorated oil rubbed in. This is rather severe treatment and may cause temporary drying up of the quarter. The worst cases may require the use of a hot poultice of flaxseed, bran, or hot rags. The disease, or at least one form of it, is contagious, so that in all cases the milk or fluid from the affected udder should be drawn into a separate pail and destroyed, and the udder disinfected externally with a five per cent. solution of carbolic acid.

Inversion of the Womb or Casting of the Withers:—The above words describe the condition where the womb, or calf bed, appears in a mass, inside out, on the outside of the cow's body. It usually follows a difficult calving, and denotes a breaking or tearing of the ligaments that hold the uterus in its proper place in the body. When a cow has once had trouble, it is liable to occur again, after any succeeding calving. The operation of returning the uterus is a difficult one. To overcome the straining of the cow, tie a quarter-inch rope tightly around the body just back of the shoulder, and another just forward of the hooks. The uterus should then be washed off with clean, cold water, with a very small trace of disinfectant. Then the mass can be slowly and carefully forced back into place with the closed fist. An occasional dash of cold water over the parts will reduce the size by driving out part of the blood. To hold the uterus in place after being returned, the lips of the vulva may be stitched for a couple of days. Or, after placing a tight surcingle around the cow's chest, two small ropes may be brought from it over the cow's back, on each side of the tail, crossed or knotted just under the tail and brought down, one on each side of the udder next the thighs, and tied tightly to the surcingle under the chest. Then the cow's hind feet should be raised six inches higher than her fore feet, for about a week. If cows, heavy in calf, acquire the habit of standing back in a deep gutter, the gutter had better be filled up level to avoid bringing on this trouble.

Lice:—These pests are difficult to eradicate in a stable. They often have a good foothold before they are noticed, particularly on animals with long, thick hair. They show their presence by the unthrifty dry appearance of the coat and loosening patches of hair. Two good washings of the whole animal, with a five per cent. solution of creolin, zenoleum, or crude carbolic acid, about ten days apart, will kill most of them. Dusting the roots of the hair thoroughly with a mixture of hellebore and dry cement is also efficacious. If the hair is very long and thick, it will often pay to clip the animal before treating.

Lump Jaw:—This is a hard growth or swelling close to the bone of the lower jaw. As it is very infectious the animal should be isolated from other cows before the swelling bursts. The only known remedy is a dose of two drams of iodide of potash in half a pint of water given every day for seven days. If the swelling does not reduce in that time repeat the dose. In the case of a valuable animal treatment may be worth while. An ordinary one might better be slaughtered as soon as the disease is noticed, as the meat can then be used. It is contrary to law to sell meat from an animal in the advanced stages of the disease.

Milk Fever:—Parturient apoplexy is another name for the same disease. This trouble affects only heavy milking cows within a few days after calving. It never attacks a heifer at her first calving, and rarely is found if the calf is allowed to run with the cow for the first week. It rarely attacks a cow whose bowels are in a laxative condition and which is being lightly fed on laxative foods, and if the cow is not milked out clean during the first three days the disease seldom occurs.

The symptoms are: Loss of appetite, uneasiness, and partial paralysis of the limbs, or inability to rise or walk. Soon the cow goes down in an unconscious or semi-conscious condition. The cow should never be drenched while in this condition, as all or part of the liquid may flow into the lungs and cause almost certain death. Of late, the disease has been found to yield readily to the air treatment. This consists in pumping the quarters full of air and confining the air by tying the teats tightly with tape. This may be done with a bicycle pump or a rubber atomizer bulb, attached by a piece of rubber tubing to a milking tube, or by the use of a special milk fever outfit of much the same nature, in which the air has to pass through a chamber filled with medicated cotton. The teats should first be partly milked out, then washed off. The tube to be inserted should also be clean and sterilized. Air may be pumped into each teat till well distended, then the teat should be tied with a tape to prevent its escape. One injection will usually be found sufficient, but it may be repeated if necessary.

Paralysis of the Bowels:—This disease sometimes attacks cows during the first few days they are turned out to pasture. It is supposedly caused by lying on the damp, cold ground. The cow refuses to eat anything, though she shows no pain at first, and gradually becomes weaker and weaker through lack of feed. In three or four days she will go down, will be unable to raise, and in a day or two will usually die in great agony. Unless taken at its inception, the disease is fatal. Strong stimulants, such as nux vomica, sulphate of iron, and bichromate of potash administered by a veterinary will sometimes work a cure at this stage.

Pneumonia:—Inflammation of the lungs, as it is commonly called, attacks cattle only in cold weather. The symptoms are lack of appetite and ambition, rapid breathing and a crackling sound in the lungs, heard when the ear is applied to the chest. The disease is usually ushered in with a severe chill, followed by a high fever. A veterinarian had better be called in, and the animal placed in a dry stall, not necessarily too warm, but free from draughts. The animal is not likely to eat, but she may take a bran mash or boiled potatoes. The medicine given should consist of a pint of raw linseed oil at the beginning, followed every three hours by a quart of thin flaxseed gruel and two ounces of whiskey. A good strong mustard plaster over the lung, left on two hours, will help relieve the pain. The animal should be kept blanketed and free from draughts till fully recovered.

Retention of the Afterbirth:—The cause of this disease has never yet been ascertained. It attacks calving cows in all the varying stages of bodily condition, age, and breeding, at all times of the year, and in all weather. It is found after most cases of abortion or abnormal birth. If the afterbirth does not come away within twelve hours after calving it will not come away naturally. To avoid the poisoning of the system by the decay of the tissues of the afterbirth in the womb, it is necessary to remove them. This should be done by at least the third day after calving. After providing himself with a pail of warm water, in which is a disinfectant, the operator should strip to the waist, wash his hands and arms in the water and coat them with some oil, vaseline or lard. The arm should then be inserted in the vagina, and the hand follow up the placenta into the womb until the first attachment is reached. This is a bulbous-like projection, or cotyledon, from which the placenta can be separated by the finger and thumb. Follow up the placenta until the tissues are all removed from the cotyledons, at all times exercising a steady pull on the end of the placenta hanging from the cow. This is a hard, tedious operation, but should be done with as little roughness as possible, to avoid bleeding at the cotyledons. After removal of all parts of the afterbirth, the uterus must be flushed out with a gallon of warm antiseptic solution. For this purpose a solution of boracic acid is advised as it is not so harsh and causes less straining. A mild solution of carbolic acid, about two per cent., will also be efficient. If there is any discharge, a second flushing out inside of forty-eight hours is to be advised.

Ringworm:—This is a fungus growth more often found on calves than in mature animals. Treatment consists in painting with iodine, or a couple of applications of sugar of lead and cream, one to four parts by weight. Kerosene oil will often work a cure, but leaves the surface raw, and retards the growth of the new hair.

Tuberculosis:—This disease is much more common in our Ontario herds than is usually supposed. This is due to the fact that animals well fed and cared for do not show any outward indications of the disease, until the disease has reached the well developed stage. There is no known cure for the disease, and treatment consists only in preventing its spread to healthy animals. The presence of the disease is indicated only by the application of the tuberculin test. Every farmer would be wise to test all his cattle at least once a year. If only a few animals react, they should be disposed of to avoid infecting the balance of the herd. In its first and middle stages the disease does not actually affect the sale of the meat. If quite a number react, so that immediate disposal would cause a severe loss, all possible means should be taken to isolate the reacting ones from the healthy cows, both in the stable and in the pasture. The calves from diseased cows are always born healthy, and if removed at birth from contact with the mothers, and fed only the milk from healthy cows, they will be as free from the disease as calves from dams that have no tuberculosis.

Warbles:—These lumps that develop on the backs of the cattle, just under the skin, are the larvae or grubs of a bot fly that lays its eggs the previous summer. Turpentine, or a mixture of one part sulphur to two parts lard, smeared on the lumps will kill the grubs as soon as they make an opening in the skin. Large warbles can be squeezed out by the hand and destroyed.

White Scours in Calves:—This is an infectious disease attacking young calves. Though due to the presence of a germ in the digestive tract, it rarely occurs where clean methods of feeding are practised. The symptoms of the disease are loss of appetite and energy, slight bloating, and an offensive white color to the manure. An immediate purgative of two ounces of castor oil is necessary, and the feed should consist of warm whole milk till the trouble abates. Many dairymen report good success from feeding in the milk a couple of tablespoonfuls of a mixture of one half ounce formalin in twelve ounces of water. Cleanliness and regularity in feeding, however, will always avoid trouble of this kind.

THE MEDICINE CHEST

The foregoing discussion on the treatment of diseases demonstrates that most of the common ailments can be successfully treated if the farmer has on hand a few of the simple remedies that are recommended for use in this connection. Every stable should be supplied with the following drugs, kept in a locked cupboard, each separate kind being distinctly labeled to avoid mistakes:

10 lbs. Epsom salts	Purgatives and Laxatives.
1 lb. ginger	
1 gal. raw linseed oil	
1 quart castor oil	
½ pint olive oil	Applications to the udders and teats.
1 lb. lard	
1 pint camphorated oil	
1 lb. vaseline	
1 pint turpentine	Bloating.
1 lb. carbolic acid	Disinfectants.
1 lb. boracic acid	
1 gal. zenoleum, creolin or chloral naphtholeum	
½ lb. sulphate of iron	Tonics and Stimulants.
½ lb. gentian	
1 pint whiskey or brandy	
½ doz sticks caustic potash	For dehorning calves.

In addition to the above the following appliances for treatment of diseases and the administration of medicines can profitably be included:

Drenching bottle with long neck.
Trocar and Cannula, for bloating.
Graduated measuring glass.
Milk fever apparatus.
Clinical thermometer.
Injection pump, or 6 ft. half-in. rubber hose with glass funnel.
Hard rubber syringe.
3 milking tubes.
Set of hand clippers.

CHAPTER XI

DAIRY BARNS AND EQUIPMENT

THE dairy farmer does not build new buildings or remodel old ones, on the average, more than once in a lifetime. When the necessity arises, therefore, for a change in the quarters of the live stock, considerable thought and planning must be given to the proposition, because once completed buildings cannot easily be altered, and mistakes and inconveniences must be put up with for many years. Careful consideration must be given to the following features of a new or remodeled building:—

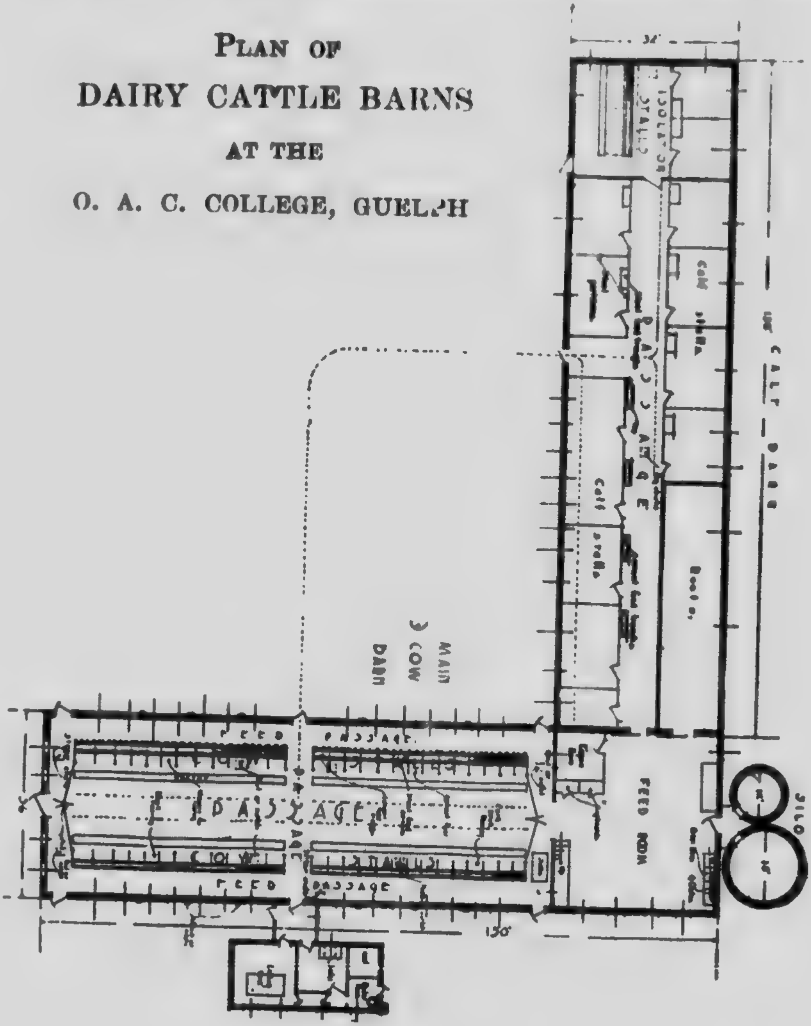
1. Capital invested in keeping with value of farm.
2. Location of building.
3. Floor space needed for animals.
4. Storage room for feed.
5. Shape of building.
6. Best materials to build with.
7. Convenience of lay-out.
8. Ventilation.
9. Light.

Capital Invested:—It is perfectly true that a farmer rarely gets much for his buildings if he sells his farm, but buildings are a necessity on all farms, and, though the capital invested therein does not yield any direct return, properly planned buildings may be the means of adding to profits by saving labor on live stock and storing crops, and by increasing the health and efficiency of the live stock. From a business standpoint, buildings should supply the necessary permanence, space, convenience, and ventilation, with the least possible investment of money in architectural effect, or fancy equipment that adds nothing to the utility or life of the building.

Location:—The first requisite in the proper location of a barn is natural drainage. No system of artificial under-ground drainage will keep dry a building erected in a low place, or remove excess surface water from such a barn yard where men, cattle, and horses are daily trampling. A side hill sloping to the south or west is the ideal place. The location should also be studied out in relation to other buildings already built, or likely to be built in the future. The dairy barn should be just a reasonable distance from the house, but ought to be as near as possible to piggery, straw sheds, and other buildings, with which the daily work of the farm necessitates constant communication. Should it be possible to build in the lee of a wind break, the location would be much improved.

Space Necessary for Animals:—In estimating the dimensions of a stable, fifty feet of floor space per animal stabled will be found about the amount necessary. This figure will provide all the necessary space for all passages, alley ways, and box

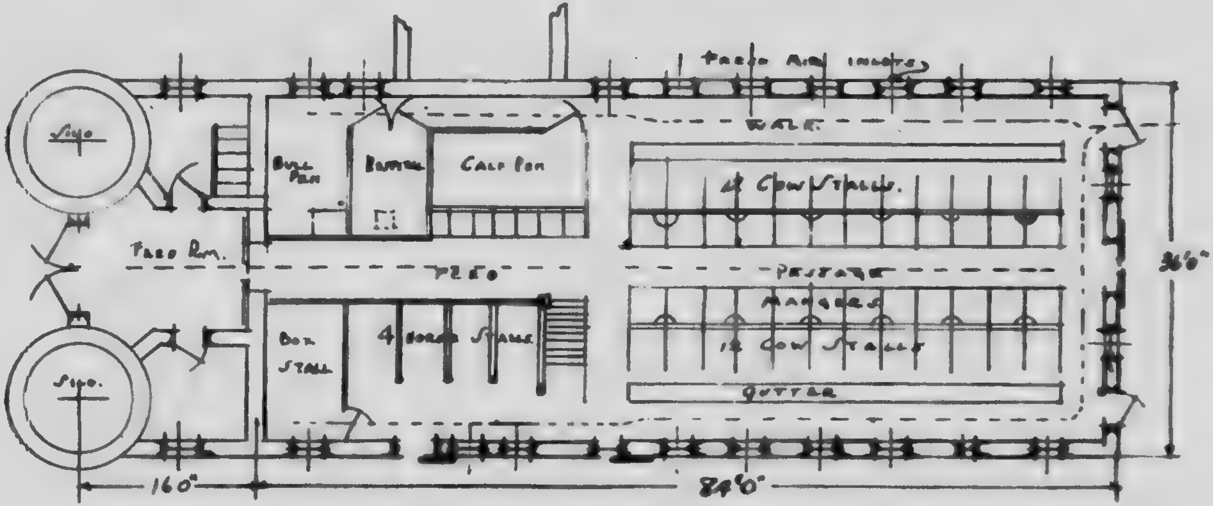
PLAN OF
DAIRY CATTLE BARNS
AT THE
O. A. C. COLLEGE, GUELPH



stalls, in addition to the space actually occupied by the cattle. A slightly smaller amount may be found convenient if a large proportion of young stock is being raised. It would not be wise to build on a much larger plan. This would provide a lot of waste room and would be too cold in most parts of the Province. To provide the necessary balance between heat and ventilation, an allowance of from four hundred and fifty to five hundred and fifty cubic feet of air space should be allowed to each animal stabled. With the amount of floor space per animal above mentioned, this cubic requirement would necessitate a ceiling from eight and one half to nine feet high. This height makes possible the best distribution of light in the stable.

Storage For Feed:—To store the necessary hay and grain for a herd of cattle, it is well to estimate on at least 800 to 900 cubic feet of space for each animal. This will also provide for one barn floor and practically all the straw that would be used for bedding. If grain is to be stored and threshed in the same barn, somewhat more space will be necessary. For silage space, provision for 150 to 175 cubic feet per animal will be found sufficient.

Shape of Building:—When the size of the barn has been decided on, the next coisideration is the shape of the building. It is now well established that the best arrangement to economize on cost of building, space, and labor of feeding, is cattle be-



A Good Barn for a 80 to 100 Acre Farm.

low and feed above. Though the separate one-story barn for cattle is often advised, a little thought will show that this arrangement involves too much labor carrying feed, and too great expense in building, to be economical under our Ontario conditions, even though there be some advantages in regard to ventilation and sanitation. In remodelling old buildings, however, where a large barn is already built that will provide storage space in plenty, it may often pay to build a one-story addition to house part of the stock. The best arrangement, all things considered—convenience, light and ventilation, is to have two rows of cattle running the length of the building. For such, a total width of about 36 feet is sufficient to provide plenty of room. Narrower barns are more expensive to build, considering capacity, while wider barns provide more stable space than can be economically used by two rows.

Where the horses, cattle. and calves are to be housed in one compact building, an "L" shaped or "T" shaped barn often lends itself to convenience of layout, with the minimum expense, particularly if there is an already erected barn that can be worked into the barn. Where it is necessary to have a threshing floor the "T" shaped barn would be preferable, with the barn floor across the middle of the top of the "T", under which wing would be housed the horses, calves, feedroom, etc. The cow stable could then be built in the upright part of the "T", over which would be stored the most of the hay. The silo could be placed in one of the angles of the two wings, convenient to feed-room. The "L" shaped barn also lends itself to some such arrangement, if the wings are so placed that the barn floor has connection with both of them.

In cases where it is considered advisable to have a great amount of storage room, it might be wise not to make the building too long and high. In this instance, if the barn were built 42 feet wide or over, the stable arrangement could provide for two rows of cattle, and a row of box stalls and calf pens, the latter being along one side. With such an arrangement, the ceiling would need to be high, with high windows to give plenty of liight to the middle of the stable. In an extra wide stable, the rows of stalls can be placed crosswise. This is not usually an arrangement that economizes space, as, in addition to the feed passages and cattle walks, there must also be a long passage the length of the stable to make connection with all parts of the stable. This is pretty near all waste room. It would, of course, be impossible in a work of this kind to enumerate all the different styles of buildings that could be satisfactorily adopted. Some of the general ideas have been outlined, and there will be found in the adjoining pages some plans of buildings that may suggest

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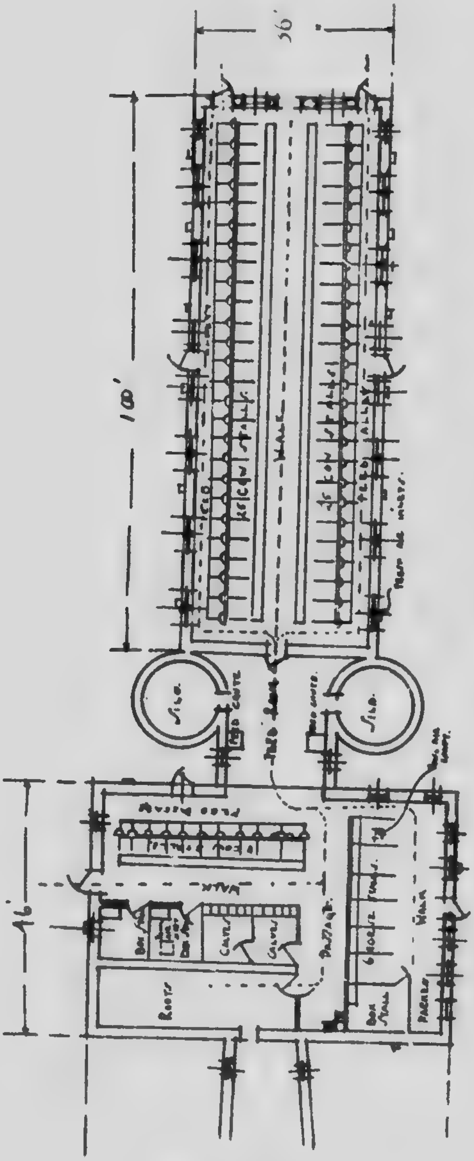
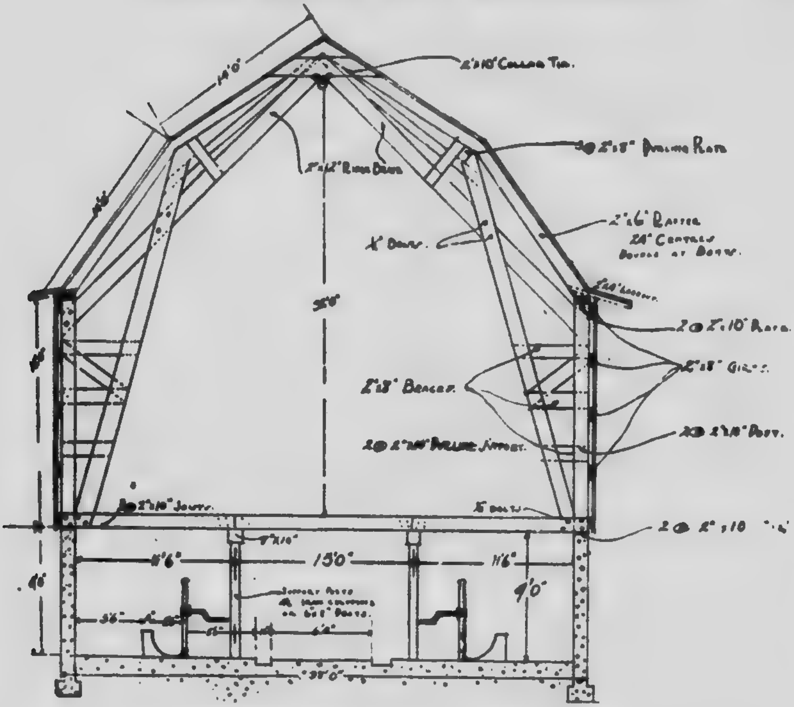


Barn for Large Dairy Farm.

to those interested some ideas that can be incorporated in their building plans.

Building Materials:—For foundations, stable floors, and, in most cases, for stable walls, nothing has yet been invented that is as satisfactory as cement. All stable floors should be of concrete, if the materials necessary—gravel, sand, and crushed stone, can be at all obtained. Cement floors are permanent, non-absorbent, and waterproof, therefore clean and sanitary. When covered with plank where the cattle stand, they are warm, dry, and cause no ill health. They require little or no repairing, and will last as long as the superstructure of the barn, and, moreover, at present prices for lumber, they are nearly as cheap at first cost as good wooden floors.

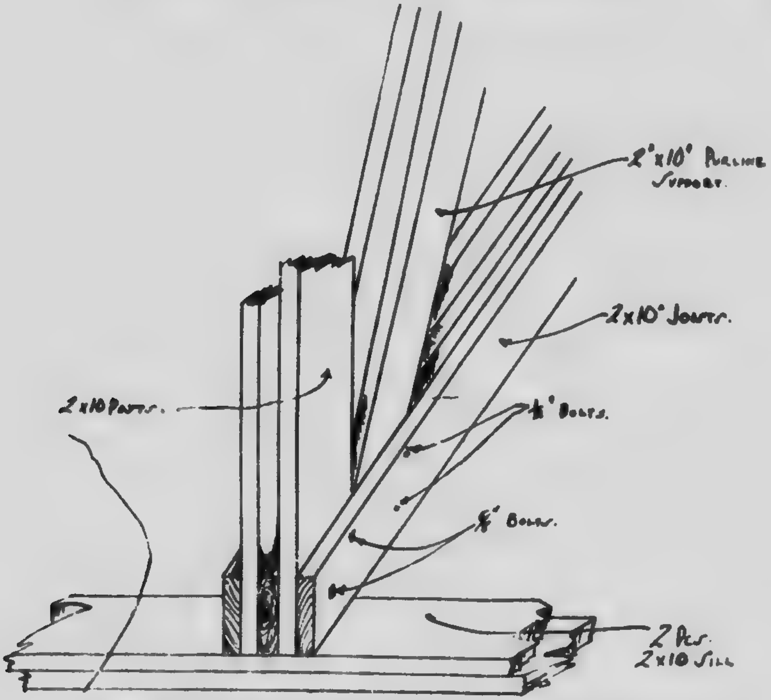
For stable walls, cement is also satisfactory, being strong, permanent, wind-proof, and waterproof. Solid walls are rather good conductors of heat, and, therefore, a trifle inclined to be damp in cold weather. For this reason the hollow concrete block, the hollow cement wall, or the brick-lined wall are to be preferred if the extra expense can be easily borne. However, if a good ventilating system is installed the solid concrete wall, if well built and smooth, will give good satisfaction. Where wood building material is available, or can be bought cheaply, this kind of wall is also satisfactory, if the points are tight and windproof, and the frame of the barn is sufficiently strong to carry



Cross Section of Good Plank Frame Barn.
Bents are 12 to 14 feet apart. End bents have no ridge brace, but have 2 in. x 8 in. girts spiked crossways every 4 feet.

the maximum weight of barn and contents in all kinds of wind storms without twisting. Wooden walls are usually dry, particularly if there is an air space in the wall and plenty building paper is used. If the animals are pretty well crowded in a stable, ordinary walls, double-boarded, only on the outside of the studding, will keep in plenty of warmth except in our severest localities. The use of galvanized iron and steel for stable and barn walls is getting some attention now. For stable walls, steel or iron outer walls, with an inside lining of wood, would no doubt be satisfactory, if cost was reasonable. For walls of mows and lofts, steel alone would be satisfactory. Steel shingles, on account of their long life, and fire-resisting powers, are being much used. Galvanized iron or steel roofs are not satisfactory for one-story stables, or where the stable air can escape into the upper barn, on account of the congealing of moisture in cold weather and dripping down when milder weather comes. All-steel barns are now being put on the market, and when prices of this material become normal these barns will find many users, as the prices of wooden building material keep advancing. The square timber frame of barns is giving place rapidly to plank frame construction, some details of which will be found on adjoining pages. Brick and stone are now out of the question, in economical barn construction, on account of the high cost of material and labor of erecting.

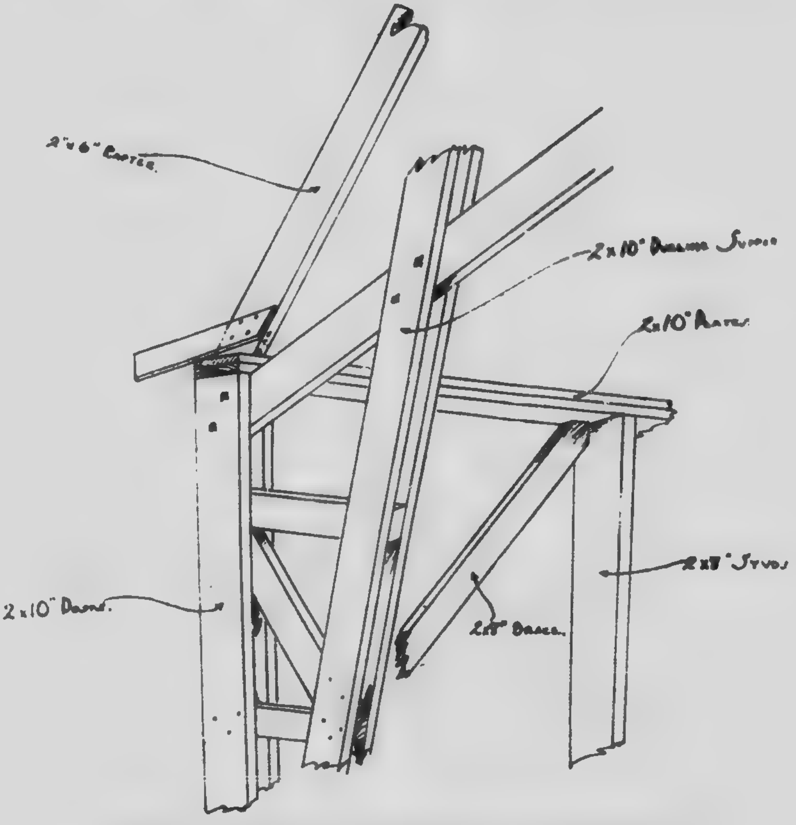
Layout of Stables:—Where two rows of cows are to be placed the length of the stable, it becomes necessary to decide whether the cows shall face the windows or face the middle of the stable. Each method has advantages that the other does not possess, but experience and observation lead to the belief that the first method is to be preferred. True, having all cows face a common feeding passage permits of greater ease in feeding, but when we consider that the actual work of feeding in a



DETAIL OF SILL IN PLANK FRAME CONSTRUCTION.

herd does not occupy nearly as much time as the milking, cleaning stables and cows, bedding, and turning cows in and out, all of which are obviously much easier done from a common passage behind the cows, we are forced to admit that the balance of convenience is on the side of facing cattle outward. Moreover, where cows face inward, it becomes impossible to keep the walls from being splashed with manure as the cows pass along the walk, while trouble in tying up cows is often caused by cows getting in the wrong passage. The hay chutes from above are better placed along the wall than in the middle, where they would be in the way of the horse-fork above. It is often possible to arrange a stable with the manure passage in the middle, so that a sleigh or wagon can be driven right through, taking up the manure from both gutters. This will be found an excellent arrangement to save handling of manure, as it may be drawn direct to the field.

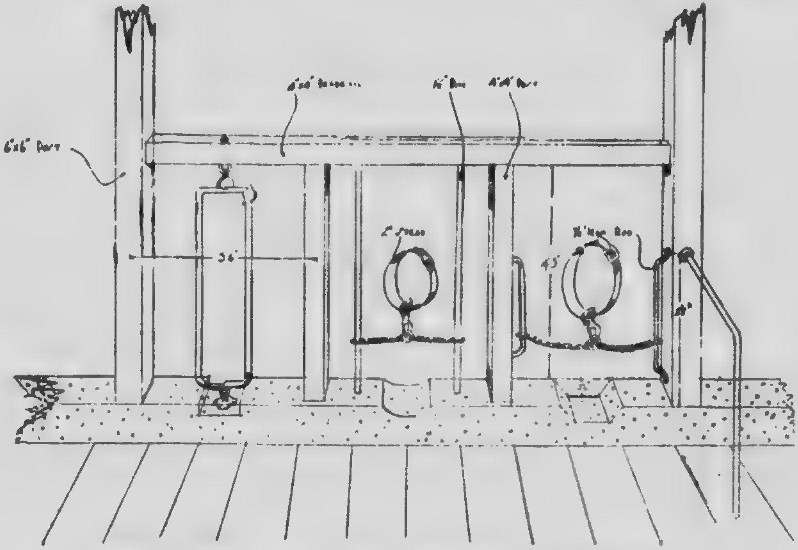
Where there is just one oblong barn, the silos



Detail at Plate in Plank Frame Construction.

should be placed at one end, preferably the north, so that they will not shut off any light from the side. The feed-room can then be placed at that end. If the barn floor is above the feed-room, the driveway can be made into a good roothouse, and the grain, feed and chop will be in a handy place for handing down into the feed-room, through a chute from the granary above. Where the barn is "L" shaped, the feed-room and silo could occupy the same place, and the wing of the barn would run off from that end, making a good connection with the feed-room, silos and roothouse. The feed-room need not be large, space to hold feed carts or barrows, a root pulper, a large meal bin, a cupboard for tools and medicine, and if necessary, a pile of mixed feed, such as silage and straw, is all that is required.

The equipment for tying, watering, and feeding cattle, should be the simplest possible, consistent with strength and safety. The swinging stanchion is, for all practical purposes, the handiest, cleanest, cheapest, and safest tie, giving also all the freedom necessary. The framework for holding the stanchion may be of wood or iron construction, either one being good, but the wood being much cheaper, 4 x 4 or 4 x 5 timber being strong enough for head rail and short posts between stanchions. With the swinging stanchion, stall partitions between cows are not necessary. In fact it is doubtful if the short partition usually extending two-thirds of the way to the gutter is of much actual use to the cow, either standing up or lying down, unless the tying is done with chains, in which case a stall partition is necessary as the cows have considerable freedom with their heads. However, if a partition is desired, a piece of inch and a half pipe, bent in a curved right angle, with the lower end in the cement floor about sixteen inches ahead of the gutter, and the upper end attached to the posts between the stanchions three feet above the floor, is all that is necessary. Posts that support the barn above, should be placed in the stable in the line of the cattle stands, as they are a nuisance if



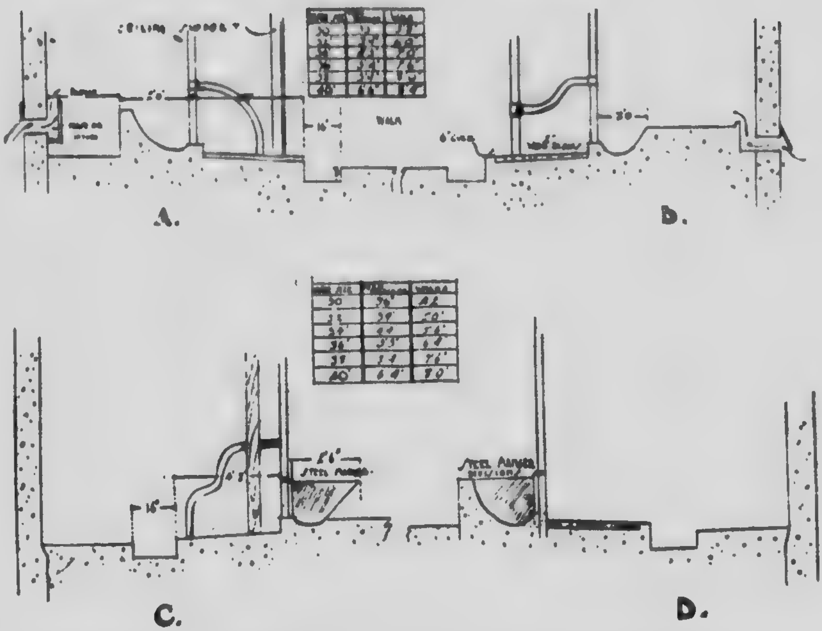
Cheap Stanchion and Cow-tie Construction.

(*a*) With stanchion no stall partitions are necessary.
(*b*) With chain-tie partitions at least between each two cows are needed.

they come in manure gutters or passage ways. The length of the cattle stand from manger to gutter will vary according to the size of the cattle. Five feet six inches will be long enough for the largest cow, while four feet six inches would be the minimum for small cows, like Jerseys, for instance. It may be found advisable to make this stand the maximum length at one end of the stable, and narrow it down to the minimum at the other end. This permits of grading the animals according to size, from one end to the other. Yearling heifers may be stood on a stand but a little over four feet long. Three feet and a half is about the correct width of stall to allow for each cow, unless the animals are extra large. For the sake of adding apparent size to the cattle, the stand should be three or four inches higher than the walk behind. The stand should have a slope of one inch from manger to gutter.

The gutter may be of varying sizes and shape, but a square-cornered gutter, about seven inches deep next to the cattle stand, and three or four inches deep next to the passage, and sixteen inches wide, will be found large enough and will cause no trouble to the cow in stepping over. The bottom should be flat, as an inclined bottom may cause a bad slip and damage to a valuable cow. On the adjoining page will be found different types of mangers and gutters.

The passage behind the cows should be at least



Good Types of Stable Floors, Mangers, Gutters and Fresh Air Inlets.

A. Measurements in centre are based on 4 ft. 8 in. length of cattle stands. Where necessary to build longer stands the extra length can be taken off width of walk and feed passages, preferably the latter.

B. For barns 32 ft. in width or less, manger and feed passage B is best,as there are no higher mangers to waste space.

C. Steel manger in C has no bottom.

D. A and D are the best styles of mangers to be used without divisions.

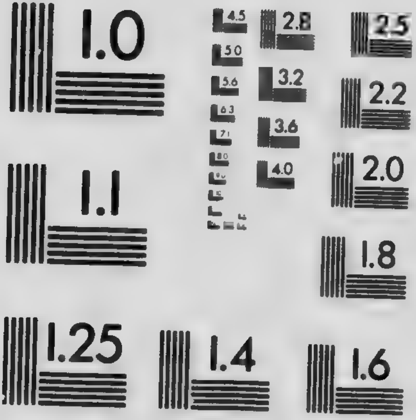
5½ feet wide, much better six to seven feet between gutters. If cows face inward, the walk should be at least four feet from wall to gutter. This passage may be only slightly crowned to drain off any water to gutters. It should never be finished with a smooth surface, as it is too slippery. While new, a sprinkling of sand should be kept on it when cows are being turned in or out.

Cement mangers are of so many different styles that a description of each kind is impossible, here. In general, they need to be at least two feet wide at the top, and to have a sloping side next the feed passage, and the bottom corners rounded to facilitate easy cleaning. A good manger can be made by raising the feed passage a foot higher than the bottom of the manger, sloping off the passage two feet from the stanchion line. Manger partitions between cows are not an absolute necessity in ordinary herds. They are needed in stables where official testing is done, to keep cows from stealing the rations of their neighbours that are being better fed. Where partitions are considered necessary in mangers, the kinds of steel partitions that can be raised out of the way are to be preferred, thus providing a continuous manger that can be easily cleaned and used as a watering trough. The use of wood for mangers can hardly be advised now. The manger bottom may be a couple of inches higher than the cattle stand.

The curb between the cattle stand and the manger should also be of cement. Six inches above the manger bottom is a sufficient height, and four to five inches thick will give sufficient strength. The middle ten inches of curb in each stall must be dropped three inches, so that the

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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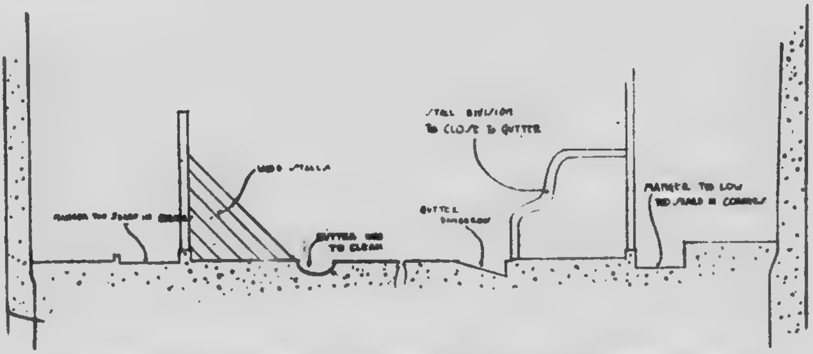
bottom end of the stanchion will let the cow's neck down low enough to be comfortable when she is lying down.

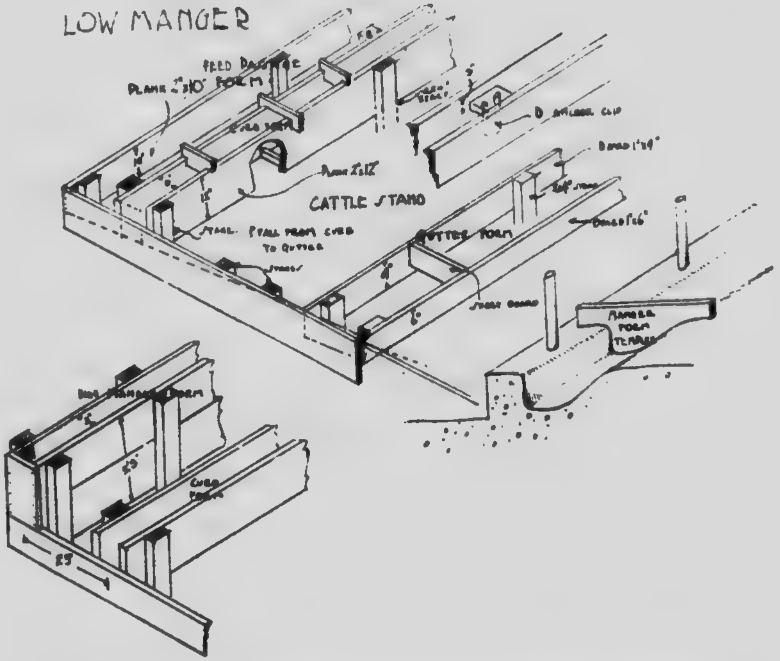


Undesirable Manger, Gutter and Stall Construction.

The feed passages may be of varying widths, but from three to five feet will be found to work out alright. As the best method of carrying silage, roots, and meal is in barrows or carts, passages should be smooth and have no abrupt steps. Where it is necessary to raise or lower the levels, this should be done by gradual slopes in the floors.

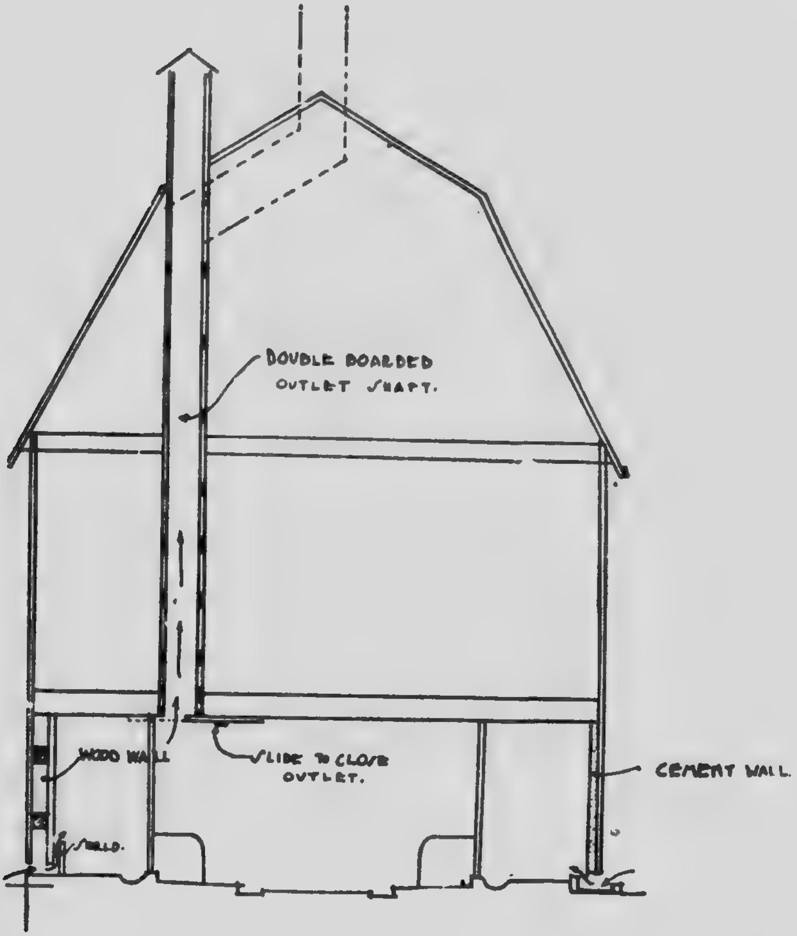
Calf pens and box stalls should be placed in a building or wing separate from the cows, if possible. Where this is not practicable, they are better placed at one end of the rows of cows. They may be of varying sizes. A couple of box stalls should be at least 9 ft. x 9ft., to use as calving pens, or for sick cows. A couple of small ones, say 6 ft. x 6 ft., or 6 ft. x 5 ft., can often be worked in to advantage, and do very well for very small calves. If the posts in the calf barn are wood, good cheap partitions can be made with strong hog fence, No. 9 wire, stretched tightly, with a wooden rail on top. If the front of the pen is made with wooden or steel calf-stanchions, with a cement manger outside in the passage, the best arrangement for feeding and economizing room is obtained. An extra large pen can occasionally be divided off with hurdles or movable partitions to make two or three smaller ones.

Ventilation:—The question of ventilation is the one usually least considered when building and remodelling stables. This should not be so, when it is considered that the maintenance of good health in the herd depends more on ventilation than on any other single factor. There can be no doubt that the great prevalence of tuberculosis in Canadian cattle is due to housing animals in the close damp air of low, unventilated stables. Moreover, a good ventilation system costs little to install when buildings are being erected or remodelled. The chief requisite of a system of ventilation is a uniform supply of fresh air without draughts, and the steady drawing off of foul damp air, without lowering the heat of the stable too rapidly. Various systems have been invented and put into use in Ontario stables. Of these, that known as the Rutherford system, is possibly the only one that gives general satisfaction in our climate. This system operates on the same principle as a stove. Fresh air is admitted at the floor, heated and fouled by the animal and raised to the ceiling, where it pases out as foul air by ventilating shafts through the roof, carrying with it the moisture that accumulates on the ceilings in our cold climate.



Form Construction for Laying Concrete Floors.

An accurate estimate has been made of the necessary size of inlets and outlets in this system. The minimum requirements are eight square inches of inlet space, and fifteen square inches of outlet space, for each animal in the stable. How-



Rutherford System of Ventilation.

Inlets 7 in. x 12 in., outlets 15 in. x 15 in. With square pitch roofs outlet may follow inside of roof to ridge of barn (see dotted line).

Where there is no horse fork in barn, outlet may run up middle of barn through the ridge.

ever, as no system of ventilation will work automatically in all sorts of weather, without causing draughts or undue lowering of stable temperature it is advisable to provide about 25 per cent. to 30 per cent. more inlet and outlet space than the above-mentioned requirements. This, of course, necessitates the use of dampers in the system, particularly the outlet system, to control the flow of air. In mild weather the system can be thrown wide open giving more than actual requirements of flow of air, and in severe weather the outlets can be closed down below the minimum size if it is found necessary to conserve heat and avoid freezing in the stable.

The inlets should each be not less than 12 inches by 6 inches, in size of opening. For twenty head, therefore, there should be 20 x 10—200 square inches of inlet, which would necessitate three inlets of the above size. These inlets should be placed about six inches above the floor line, being holes right through the wall with a wooden or tin shield on the inside to deflect the incoming fresh air upward, so it would not blow directly on the cows. Or, the inlets may come in through the foundation just below the wall, and open directly upward in the passage, covered by a grate or surrounded by a 4 inch curb to keep out dirt. The outside opening should also be protected by a sloping cover, to keep out rain and snow.

The outlets for foul air should each be at least

15 in. x 15 in. Smaller outlets cause too much friction to provide a smooth flow of air. For twenty head of cattle, as above, the best outlet space would be 20 x 20—400 square inches.

This would require two outlets, 15 inches square, or two circular ones each 16 inches in diameter. These flues should be smooth inside and tightly built for proper circulation, and should extend out through the highest part of the roof and be topped by a cupola to keep out rain and snow. If it is desired to bring them out part way down the side of the roof, the top of the cupola must extend higher than the ridge of the barn, in order that eddies of wind, formed by the roof, shall not interfere with the draft in the outlets. At the bottom of the outlet shaft there should be a damper or trap-door that can be operated by a rope, or else a sliding trap-door that can partly or entirely close up the outlet if necessary in severe weather. The outlets should leave the stable above the backs of the cows, as near the heads as possible. The space necessary above for horse-fork room, in most barns, prevents the outlets being built in the middle of the barn.

This Rutherford system has the great advantage of being cheap of construction. More expensive systems have been advocated, such as the King system, which has proven a failure in this cold climate, principally because it draws out the foul air from near the floor and makes no provision for drawing off at ceiling the moist air that causes dampness in our cold weather. In this connection it is well to mention that even the Rutherford system will not entirely carry off the excess moisture from ceilings that are not ceiled below the joists. The joists cause pockets that interfere with the free circulation of air. It is well to remember that no system of ventilation will work automatically. They all need control, and success will depend on the attention they get, particularly in cold weather.

Light:—Light is one of the best disinfectants and germicides known to science, and, as it is absolutely free, stables should have as much as possible. Windows should be large, high, and as frequent in the walls as strength of building will allow. Six square feet of glass for each animal stabled is not too much, and if the stable is low, seven feet would give better results. The best construction of window is one that swings open from the top. This deflects the wind upward toward the ceiling, preventing serious draught on the cows. In districts where cold is very severe, double windows will be found very useful in keeping the stable warm, and preventing the heavy accumulation of frost on the inner windows. This accumulation shuts off light and makes the interior of the window frames very sloppy at thawing time.

CHAPTER XII

FINANCIAL RETURNS FROM THE DAIRY FARM

IN preceding pages attention has been called to the high position occupied by the dairy cow as an economical producer of human food. In this respect she stands at the top in the realm of farm live stock. Moreover the product which she supplies for the world's market removes a minimum of elements of soil fertility so necessary for the continued prosperity of agriculture and the maintenance of a world's supply of food in the face of an increasing world population. It is to be expected therefore that this efficiency of the cow would lead to satisfactory farm profits for those farmers who use her as the basis of their live stock operations.

The writer has had the privilege during the past three years of conducting investigations into the financial condition of different types of farming conducted in Ontario. These various types include dairy, beef and mixed farming. The figures of a full year's business for the year 1917 and 1918, on each of 350 to 400 farms in two dairy districts, Oxford County in Western Ontario and

Dundas County in eastern Ontario were collected and analyzed for the purpose of discovering the financial returns of dairy farming and the factors that make for increased profits in the organization of a dairy farm in actual practice.

In collecting the data, record was made of the following items:

1. The number of acres under each crop grown, and in pasture, waste or wood lot.
2. The yields of the various crops, and the amount of each sold during the year.
3. The amount of feed on hand at the beginning and end of year, and the amount purchased during the year.
4. The number and values of each kind of live stock, at the beginning and end of the year, together with purchases, sales and deaths, of animals within the year.
5. Receipts from all live stock products—milk, eggs, wool, hides, etc.
6. An itemized account of current expenses: taxes, labor, repairs to buildings and machinery, threshing, silo-filling, binder twine and future life of each building and machine.
7. Valuation of buildings and machinery, with an estimate of the future life of each building and machine.
8. Valuation of the farm itself, in order to arrive at the total amount of capital invested in the business.

Labor Income

The labor income is the basis upon which the comparison of different farms is made. It is the measure of profit or loss on the farm business for the year. To permit of a clearer understanding of what the term implies, a brief outline of the method employed to calculate the labor income is given below:

1. All farm receipts for the year are totalled: crops sold, live stock and stock products sold, increase in value of young stock, miscellaneous.

2. All expenses for the year are totalled: current expenses as outlined in a preceding paragraph, depreciation on buildings and machinery.

In "current expenses", a charge is made for the labor performed by members of the family who work for no stated wages. The farmer is asked to estimate the amount he would have to pay out if he had to hire men to do the work which is done by his family. This places the farmer with no family on an equal basis with the man who has a large family.

In calculating the total receipts and total expenses, due allowance is made for any increase or decrease in the value of mature live stock, for stock purchased, and for any difference in the amounts of feed on hand at the beginning and end of the year.

3. From the total receipts is deducted the

amount of total expenses, and the balance is the farmer's net revenue for the year—the earnings of both his labor and his capital invested.

4. Interest at 5 per cent. on the total capital invested is calcluated and deducted from the amount of net revenue. This leaves only the amount earned by the farmer's labor and managing ability—which amount is termed Labor Income.

If then the "net revenue" of a farm (as defined in clause 3 above) does not amount to as much as 5 per cent. on the capital invested, that farmer is said to have a "minus" labor income—that is, he has worked for less than nothing, for the capital would have brought in at least 5 per cent. in any secure investment, with absolutely no labor on the part of the farmer. On the other hand, if the "Net Revenue" of the farm is several hundreds, or thousands, of dollars greater than 5 per cent. interest on capital, that difference is caused by the successful work and good business management of the farmer.

The data collected in the above manner provided sufficient information on which to determine the Labor Income or Farm Profits in the two dairy districts mentioned for the years 1917 and 1918. The following table sets forth the main features of the farm finances of these districts for those years.

	Oxford County		Dundas County	
	1917	[illegible]	1917	1918
Number of Farms	363	[illegible]	278	290
Average Size of Farm	113 ac	[illegible]	103 ac	103 ac.
Average Gross Receipts per Farm	$3446	[illegible]	$3029	$3060
Average Current Expenses per Farm	$1194	[illegible]	$1174	$1179
Average Depreciation Buildings and Machinery per Farm	$268	$270	$260	$271
Average Interest on Investment 5%	$732	$765	$671	$757
Average Labor Income per Farm	$1198	$1248	$904	$882

The above table illustrates the capacity of average dairy farms in Ontario in respect to total income, expenses, overhead, and owner's return for his labor. As will be noticed the returns for Oxford County are higher in respect to total income and labor incomes in both years while expenses and overhead depreciation and interest are practically the same in both districts. Oxford County dairymen have the advantage of a slightly better soil and more years of dairy experience which have developed a slightly higher average of productivity in cows and better methods of breeding and feeding. It was discovered that the average milk yield per cow on the Oxford County farms investigated was 900 pounds more than the average Dundas cow.

Another feature worth noting on the above table is the increase in average labor incomes of $50.00 in Oxford in 1918 over the same farms in 1917 while Dundas farms showed a decrease of $22.00 per farm during the same period. During 1918 Oxford County enjoyed the best crop year in its history which resulted in much smaller feed purchases than the previous year though the increase in other farm expenses in the same time practically absorbed the saving in feed, as shown by the similarity in current expenses for the two years. Dundas County on the other hand had a very unfavorable season. The summer and autumn were very wet, preventing the harvesting of, in good shape, the grain crops and the silage corn and roots. On half of the farms visited the latter crops could not be harvested at all. Even the increased price for milk during that year and the abundant pastures could not make up for the losses occasioned by the wet harvest.

In summarizing the financial returns from dairy farming it has been shown that as conducted in the dairy districts of Ontario, the gross returns per acre are about $30.00, the ordinary expenses $10 to $11 per acre, the overhead charges (interest and depreciation) $9 to $10 per acre leaving a return to the farmer for his labor and management of $9 to $11 per acre.

The above figures of course, are average figures and while the majority of farms in the main approximate these returns, there are some wide variations in returns on individual farms. The following table shows some of the extremes in returns in these same districts during 1918.

	Best Farms		Poorest Farms	
	Number	Average Labor Income	Number	Average Labor Income
Oxford County	78	$2414	19	—$512
Dundas County	53	$1900	18	—$489

It is quite apparent from the above that quite satisfactory profits can be made from dairy farming under the right management and organization as about 20 per cent of the farms in both areas returned the operators an annual salary of an average of $2,000 or over. Moreover it is also true that dairy farming in itself is not an assurance against farmers making less than nothing for their labor; some in fact did not make interest on their capital invested.

It might further be interesting to compare the returns from dairy farming in 1918 with those from other types of farming in Ontario in the same year. The following table sets out a comparison of Oxford County dairy farms with a similar number of mixed farms in the counties of Dufferin and Peel and beef raising farms in the county of Middlesex.

	Oxford Dairy Farms	Dufferin Mixed Farms	Middlesex Beef Farms
Average Size of Farm	113 ac.	152 ac.	153 ac.
Average Capital per Farm	$15305.	$13650.	$16870.
Average Gross Income per Farm....	$3559.	$2831.	$2854.
Average Gross Income per Acre	$31.50	$18.60	$18.60
Average Current Expenses per Farm.	$1212.	$940.	$990.
Average Current Expenses per Acre..	$10.80	$6.20	$6.50
Average Labor Income per Farm...	$1248.	$937.	$780.

The above table quite clearly illustrates that the dairy cow not only provides a large gross revenue for the food consumed but that she also pays the farmer an extra wage for the extra effort and labor involved in caring for her. It is only fair, however, to point out that the mixed farming area mentioned above has not as great advantages in natural fertility of land as the Oxford County district and also athough the Middlesex district is nearly as fertile as the Oxford area, much of the tillable land in the former is devoted to grazing which is not productive of high revenue per acre although permitting of saving in labor outlay.

As the farm areas differed considerably in the above table it is interesting to compare the same types of farming on the basis of returns for capital invested as in the following table:

	Oxford		Dufferin		Middlesex	
Total Capital Invested	**Average Size of Farm**	**Average Labor Income**	**Average Size of Farm**	**Average Labor Income**	**Average Size of Farm**	**Average Labor Income**
$ 7300–$ 8200	48 ac.	$ 559	98 ac.	$ 498	70 ac.	$ 235
9500– 11500	78 ac.	900	110 ac.	812	100 ac.	560
13000– 15000	96 ac.	1150	163 ac.	1018	118 ac.	618
15000– 17000	114 ac.	1327	178 ac.	1000	151 ac.	900
19000– 21000	160 ac.	1650	229 ac.	1339	200 ac.	1000

The foregoing illustration still further strengthens the claim of the dairy cow as a leader in the organization of the live stock industry by pointing out her value as a factor in increasing the volume of capital and therefore business that can be profitably concentrated on a given acreage. While for actual capital invested the profit in dairy farms is not markedly greater than that in the mixed farms, a comparison of those farms in the table that are of about equal size points out a great increase in labor incomes and capital invested which means more business on the same area.

CHAPTER XIII

THE SIZE OF THE DAIRY FARM

THERE is a well recognized business principle that size and volume of business have an important bearing on the financial result of any enterprise. All other conditions being equal the larger the business the larger the profits. Whether this is entirely true in respect to farming has long been a matter of doubt even among the most thoughtful students of farm economics, especially when size is carried to extreme limits. It is true that the majority of extremely large farms in Eastern Canada, say those of upwards of 800 acres, have not been successful in a business sense. It is supposed also that most moderately large farms have not been successful in the economic sense in as much as they have not produced as much per farm or per acre as the smaller farms. Whether this is generally true or whether this supposition is due to the special impression made by the few failures merits some consideration. The Department of Farm Management of the Ontario Agricultural College in its investigations mentioned in the previous chapter presents some valuable information on this subject. These investigations in the Counties of Oxford and Dundas covered a wide range in size of farms, the profits on which are shown in the following table:

		OXFORD COUNTY			DUNDAS COUNTY		
Average Size in Tillable Area	Year	No. of Farms	Average Actual Size—Acres	Average Labor Income	No. of Farms	Average Actual Size-Acres	Average Income Labor
Under 46 acres.....	1917	80	51	$ 524	27	47	$ 399
	1918	21	48	785	22	46	396
46 to 60 acres......	1917	41	60	719	49	62	555
	1918	38	61	936	50	61	662
61 to 75 acres	1917	47	90	763	36	83	853
	1918	49	91	868	39	85	812
76 to 90 acres	1917	88	103	1237	54	99	983
	1918	77	104	1158	61	98	879
91 to 110 acres.....	1917	68	114	1296	61	114	1080
	1918	72	114	1827	68	117	968
111 to 135 acres....	1917	41	147	1533	34	159	1061
	1918	36	147	1440	31	152	1110
136 to 160 acres....	1917	22	173	1873	8	185	1460
	1918	23	179	1881	9	178	1260
161 to 185 acres....	1917	11	219	2016	9	236	1738
	1918	10	201	2159	10	233	1691
Over 185 acres	1917	15	245	2282			
	1918	10	263	2449			

Note:—All farms in the Dundas area over 160 [illegible] in tillable acres are included in the 161-185 acres column.

The above table is quite plain in expressing the influence of size of farm on farm profits under average conditions. The increase in Labor Income in both areas in both years keeps pace with the size of farm. The chief reason for this condition is that the increased volume of business done on the larger farms gives the owner greater opportunity for having a large remainder of profits after all expenses are met.

Another cause which contributes greatly to the larger profits of the bigger farms is the proportionately smaller amounts of capital tied up in buildings and machinery on the larger farms. Buildings and machinery are a vital necessity on every farm but by themselves they do not produce any revenue as land and live stock do, and if a large proportion of the farm capital is devoted to these two items there must be a proportionately smaller share invested in revenue-producing enterprises such as land and live stock. A study of the table below dealing with 290 Dundas County farms in 1918 will demonstrate this point.

It will be noted from the following table that the non-productive capital,—money invested in buildings and machinery—is 46% of the total capital on the small farms but decreases to 29% of the total capital on the largest farms. This means that the larger farms have a greater proportion of their capital devoted to land and live stock which are the revenue-producing part of the farm business, also that the larger farms have a smaller cost of operation in proportion to the business done.

Average Capitalization on Different Sized Farms

Size of farm Tillable land	Total Captial	Capital in Real Estate	Capital in Buildings	Capital in Machinery	Per cent. of Total Capital in Bldgs. and Machinery
Under 46 ac.	$ 7270	$ 4855	$ 2662	$ 653	46%
46—60 ac.....	9241	6019	2770	806	39%
61—75 ac.....	11362	7628	3075	918	35%
76—90 ac.....	13592	9070	3732	1101	35%
91—110 ac...	16895	10906	4399	1727	36%
111—135 ac.	19183	13068	4627	1840	34%
136—160 ac.	20302	13111	5181	1792	30%
Over 160 ac.	27274	19400	5181	1779	29%

Again there can be greater efficiency of man and horse labor on the larger farms. The operators of the small farms averaged only 20 acres of crops per man and 10 acres per work horse while the operators of the large farms averaged 50 acres of crops per man and 20 acres per work horse. This saving on the part of the larger farms was accomplished with practically no decrease in the yield of crops. This feature is clearly set out in the following table dealing with the same farms.

Size of Farm Tillable Land	Acres of Crops Per Man	Acres of Crops Per Horse
Under 46 acres........	20	11
46—60 acres	26	13
61—75 acres	32	14
76—90 acres	34	15
91—110 acres	35	15
111—135 acres........	39	17
136—160 acres........	38	19
Over 160 acres........	50	20

The previously-mentioned factors that contributed largely to the higher average profits of the larger farms are also clearly expressed in the following table dealing with 363 Oxford County farms for the year 1918:

Size (Tillable Acres)	21 to 45	46 to 60	61 to 75	76 to 90	91 to 110	111 to 135	136 to 160	161 to 185	Over 185
Total Capital	$7576	$9463	$12538	$14338	$15568	$19203	$21241	$24265	$36186
P.c. capital in Buildings	36	30	27	27	26	24	23	23	24
P.c. capital in Machin'y	7.5	6.9	6.8	7.0	6.3	6.3	5.5	5.3	5.4
P.c. capital in Live Stock	20	22	22	22	22	22	22	23	22
Crop Acres per man	28	30	28	33	36	36	40	44	44
Crop Acres per horse	13	15	14	14	15	18	17	18	18
Live Stock Index	108	108	93	100	101	99	91	95	92
Crop Index	100	102	96	101	101	96	100	96	107
Gross Receipts	$1835	$2362	$2784	$3397	$3662	$4424	$4970	$5755	$7486
Labor Hired	$84	$184	$352	$415	$400	$670	$666	$607	$1094
Labor Income	$735	$936	$868	$1158	$1327	$1440	$1881	$2159	$2449
	10 FARMS	10 FARMS	10 FARMS	10 FARMS	10 FARMS	10 FARMS	8 FARMS	5 FARMS	5 FARMS
Labor Income on Best Farms	$1236	$1804	$1975	$2695	$2772	$2695	$2769	$3192	$3691

There are two seeming irregularities in the above table. The average labor income of the 61-75 acre group is slightly smaller than the average of the 46-60 acre group. Likewise the average labor income of the 111-135 acre group is very slightly larger than the average of the 91-110 acre group. A similar effect may be noticed in the labor incomes of the ten best farms in these groups. The increase over the previous group is not as great as increase in size of farm would seem to warrant. This same result was found in the first survey of Oxford and in the first survey of Dundas County to a slighter extent. The explanation of this seeming peculiarity lies in the fact that for dairying purposes, the 61-75 acre and 111-135 acre farms are what might be termed "odd-size farms". The nine groups of farms in the above table split naturally into three divisions:

1.

One-man farms	21 to 45 Tillable Acres. 46 to 60 Tillable Acres. 61 to 75 Tillable Acres.

2.

Two-man farms	76 to 90 Tillable Acres. 91 to 110 Tillable Acres. 111 to 135 Tillable Acres.

3.

Three-or-more-man farms ....
136 to 160 Tillable Acres.
160 to 185 Tillable Acres.
Over 185 Tillable Acres.

The 61-75 acre farm is slightly too large to be handled successfully by one man, but is still too small to permit of an organization that will efficiently employ two men's labor. The operator of a farm of this size, therefore, usually tries to worry along by himself or else is forced to employ the unsatisfactory transient or "floating labor". In consequence, we find that in both live stock and crop production this group of farms is below the district average. Practically the same features are found in the 111-135 acre farms. They are too large for two men but too small to keep three men profitably employed. They employed as much labor as did the next larger group but their gross receipts were $546 per farm less.

To operate one of these "odd-size" farms at maximum profit requires greater managerial ability than to operate a farm of any other size. It will be remembered, of course, that the division of farms was based on the "tillable area" which has already been explained. To get back to the actual number of acres in these farms, one must refer again to the first table of this chapter. It shows that the farms of 61-75 tillable acres are really 91 acres in extent, while the 111-135 acre group averages in size 147 actual acres.

Although it has always been conceded by the majority of men that the larger farm will yield more profit than the smaller, it has not been, and is not now, possible for all men to acquire large acreages. Those who have the smaller farms must strive therefore, to overcome this deficiency by a better organization of their business as it stands. Nor is this impossible by any means. The above table shows that certain farmers in Oxford County are working to better advantage than their neighbors, despite the handicap of small acreage. The ten best farmers having 21-45 tillable acres made an average labor income of $1,236, which is more than the average farmer on the 76-90 acre farm. Likewise, the ten best farmers on the 76-90 acres of tillable land, which is the average 100-acre farm, (see note on "Tillable Area") made an average labor income of $2,695, which is $246 more than the average of the ten farms over 185 acres in extent.

The largest farm does not seem necessary for the making of satisfactory profit. The financial returns disclosed above, substantiated by almost identical figures procured in the two years of the Dundas County investigations, brings home forcibly this conclusion that while the really small dairy farm is a handicap in the race for large profits a farm slightly over 100 acres offers all the opportunities existing for the making of a comfortably large income and given a farm of that size improved methods will yield as great returns as increased acreage.

Chapter X.

THREE FACTORS THAT MAKE SUCCESS.

Crop Yields—Good Live Stock—Economy

TO every dairyman it is evident that success in his business is to have the proper degree of perfection in, and the correct balance of, the three factors that provide the heading of this chapter.

The success of any class of farming is dependent on the gross amount of foods and fodder that the land annually produces. Should the land fail to produce, the whole structure of agriculture would fall and mankind itself would be destroyed. even a small decrease in the annual harvests of the world upsets the balance of agriculture through its effects on the animal industry as well as on the bread supply of the world. The individual dairyman even in his own selfish interest will see that his crop yields are as large as possibe, but this will not in itself assure him success in his own operations. His purpose in tilling land is to grow raw material to put into a factory, the dairy herd, to produce a manufactured product, milk. If his raw material in its course through the factory contracts or shrinks materially through bad factory methods or poor machinery, then he cannot make satisfactory yearly profits, be his yields of raw material ever so large. His profits from good crops may disappear as those crops pass through the herd. Good crops alone or good live stock by itself will not give the greatest profits; there must be a proper balance between them in their combined march forward to greatest success. Nor will this goal be reached unless their comrade, farm economy, guide them on their upward way. From the beginning of time in all lands the tiller of the soil has had to closely watch his expenditures. Each one has had millions of competitors, by training, and by instinct, through generations of experience nearly as efficient as himself. Each one individually and collectively is dependent on circumstances of weather and season in the sole control of Providence. Therefore, farming cannot now and possibly never will permit extravagant expenditure either for farm or personal purposes. The necessity for business economy is the great balance wheel of agricultural enterprise.

As crops are the foundation of dairy husbandry it might be interesting to point out the effect of good or poor yields on ultimate yearly profits. For this purpose the following table derived from the Oxford farm survey investigations of 1918 are presented.

INFLUENCE OF CROP YIELDS ON LABOR INCOME

Crop Yields	No. of Farms	Labor Income	Labor Hired Per Farm	Crop Acres Per Man	Crop Acres Per Horse
Under 81% of average	80	$624	$297	34	14
81—90% of average..	65	1148	406	36	15
91—100% of average.	81	1173	431	33	15
101—110% of average	81	1435	461	33	15
Over 110% of average	71	1510	452	32	15

The first logical step toward increase in farm profits lies in improved cultural methods, and thereby increased crop yields per acre. The table above shows that the 71 farmers in Oxford County who had crop yields of more than ten per cent. above the average made average labor incomes more than twice as great as those having crop yields twenty per cent. or more below the average. The advance in labor income in the intermediate groups is in accord with the increase in crop yields. There was very little difference in the crop acres worked by each man and each horse in the different groups, and with the exception of the very low group, practically the same amount of labor was employed. So, while it is not within the scope of this work to discuss cultural methods, it can be stated with certainty that the man who is furthest on the road to success is the man who studies the latest scientific data on cultivation of the soil. drainage, fertilizers, weeds and plant diseases and who makes the most practical application of the knowledge so gained, to the conditions peculiar to his own farm.

The average yields of the main crops grown on 351 farms in Oxford County, in 1918, were:

Hay	1.9 tons per acre.
Oats	52 bus. per acre.
Barley	43 bus. per acre.
Mixed Grain	50 bus. per acre.
Silage Corn	8.8 tons per acre.

In an essentially live stock district, the greatest single factor of profit or loss in the farming business is the quality of live stock. Poor live stock, or good live stock poorly handled, are never known to show a balance on the proper side of the ledger. The following table of the same farms as in the above table was prepared to show just how great an influence this factor does exert.

Good Live Stock and Labor Income

Quality of Live Stock	No. of Farms	Labor Income	Feed Bought	Labor Hired Per Farm
Under 71% of average	35	$ 14	$206	$425
71—80%	34	761	140	354
81—90%	48	948	231	425
91—100%	61	1310	233	446
101—110%	51	1498	266	417
111—120%	32	1610	296	368
121—130%	27	1872	338	549
Over 130% of average	40	2047	422	433

The labor income column of the table shows a steady increase as the quality of live stock improves—or as the receipts per animal unit increase. More feed was required for the more highly productive stock as shown by the "feed bought" column, but it was considerably more than repaid. There was very little difference in the amount of labor required.

Although not shown in the table, it is interesting to note that each of the four groups below 100 per cent. (of average) in receipts per animal unit, contained two or more farms having "minus" labor incomes, whereas no "minus" labor incomes appeared in the four groups above 100 per cent.

In a dairying district such as Oxford County, "quality of live stock" may be interpreted as "quality of milch cows". Hence the farmer, who wishes to increase his labor income most quickly and surely, must give strict attention and considerable thought to the breeding and feeding of his herd, for milk production. In studying the above table it has been seen that both crop yields and receipts per unit of live stock exert an influence on the farm profit or labor income.

Comparative Effects of Good Crops and Good Live Stock on Amount of Labor Income

Farms with	Poor Live Stock.	Medium Live Stock	Good Live Stock
Poor Crops	No. of farms—39 Labor Income $449	No. of farms—36 Labor Income $1335	No. of farms—20 Labor Income $1398
Medium Crops	No. of farms—68 Labor Income $674	No. of farms—50 Labor Income $1398	No. of farms—54 Labor Income $1909
Good Crops	No. of farms—20 Labor Income $786	No. of farms—26 Labor Income $1478	No. of farms—25 Labor Income $2184

The above table was prepared to determine which of these two influences was the greater. The farms were divided first into three groups—according to whether their crop yields were "poor" "medium", or "good". Then each of these three groups was divided into three smaller groups—according to whether the live stock was poor, medium or good. This gave nine groups, as shown:

39 farms with Poor Crops and Poor Stock
36 " " " " Medium Stock
20 " " " " Good Stock
68 " " Medium " Poor Stock
50 " " " " Medium Stock
54 " " " " Good Stock
20 " " Good " Poor Stock
26 " " " " Medium Stock
25 " " " " Good Stock

The groups are arranged in the table in such a manner that a comparison of the influences of crop yields and stock returns is very simple. To discover the benefit of good crops over poor crops, one must compare the three groups in each of the vertical columns. For example, take the column headed "Poor Live Stock". The quality of the stock is exactly the same in each of the three groups in this column. Therefore, the rise of $337 (from $449 to $786) in labor income must be due to the increased yield per acre of the farm crops. In the next vertical column where the stock is of the same quality in each of the three groups (although better than in the preceding vertical column), there is an increase in labor income of $148, due to the influence of good crops. In the third vertical group or "Good Live Stock" farms, the increase due to crops is $736.

Then to determine the influence of quality of live stock, where the crop yield remains constant, one must study each horizontal column within itself. For example, take the first horizontal column, which is headed "Poor Crops". All the farms in this column had low crop yields, but thirty-nine had poor live stock, thirty-six medium live stock and twenty good live stock. The advance of $949 in labor income (from $449 to $1,398) was due therefore, to higher receipts per animal unit. In the second horizontal column, all the farms had medium crop yields, but those who had good stock made $1,235 more than those who had poor stock. Likewise, in the "Good Crop" column, quality of live stock was responsible for an increase of $1,348 (from $786 to $2,134) in labor income.

On making these comparisons, it will be noted that the increase due to improved live stock is very much greater than that due to increased crop yields. Again, compare the first vertical column with the top horizontal column. Each of these columns begins with the same group, that with poor crops and poor live stock. Now where the stock remains constant and the crop yields increase, the labor income rises from $449 to $786, but where the crops remain constant and the quality of live stock increases the labor income increases from $449 to $1,398. The conclusion must be reached, therefore, that quality of live stock is a more potent factor in determining farm profit than is yield per acre of farm crops. This does not mean that cultivation, drainage, crop rotation, control of plant diseases, etc., are things which can be neglected, but it does mean that a dairyman may have crop yields far above average and yet show a loss on the year's business because his crops were fed to cows which were incapable of producing milk profitably. The dairy herd is the dairyman's market for his grain, hay, silage and roots. If that market be unprofitable, the more he sells through it the greater is the loss he sustains.

The claim is made by some farmers that success cannot be attained in the farming business except by dint of the most rigid economy in operating expenses. With a view to ascertaining the correctness of this contention, a tabulation was made from 328 farms of Oxford County, in 1918.

The results are shown in the following table:

Economy in Farm Expense

Current Expenses	Farm Efficiency	No. of Farms	Labor Income	Live Stock Index	Crop Index	Labor Hired	Feed Bought	Crop Acres Per Man	Animal Units Per Farm
Low	Good	26	$1522	98	100	$214	$ 76	38	21
	Poor	47	524	79	93	210	72	37	20
Low Medium	Good	41	1835	108	103	303	161	34	25
	Poor	42	661	86	92	354	143	34	23
Average	Good	30	1997	111	102	580	285	35	31
	Poor	31	636	91	95	566	190	33	28
High Medium	Good	28	2221	116	104	491	374	33	30
	Poor	20	636	99	100	594	298	32	28
High	Good	34	2221	129	110	635	603	30	31
	Poor	29	449	98	102	565	579	28	25

The farms were divided into five groups as shown, according to the current expenses—low, low medium, average, high medium, and high. Due allowance was made, of course, for size of farm. A large farm necessarily requires the expenditure of more money for running expenses than does a smaller farm. The farms were first divided according to size. Then, if the current expenses of a farm were low, according to the average of the group to which it belonged, it was put in the "low" group for this tabulation. In similar manner all the groups were sorted out. This method put farms of all sizes in each group in this table and caused the average size of each group to be practically the same. A subdivision of each group was then made, according to whether the labor incomes were above or below average.

Those having a higher labor income than the average were termed "good", and those below average were termed "poor".

The contention that rigid economy is the only key to success was immediately disproven. Of the 73 farms in the low expense group, only 26 were above the average in labor income. And on comparing the "good" farms of each group, it is seen that the labor income rises steadily with the increase of farm expenses. This is due to the fact that the added amount of labor and feed (which are the two chief variable items of current expense), caused a steady climb in returns from live stock and yield per acre of crops. Nevertheless, farming does pay a premium for hard work and economy. The 26 "good" farmers in the low expense group, with returns from live stock two per cent. below the district average and crop yields exactly average, made an average labor income of $1,522, whereas the average labor income of all 328 farms was $1,248. These farmers must have naturally productive live stock, for they could not have fed heavily, as they carried 21 animal units per farm and yet purchased only $76 worth of extra feed. But these men worked 38 crop acres each, and with help for about four months only (as is indicated by the labor charge of $214), cared for 21 units of live stock. The number of hours which they had for recreation and pleasure were not plentiful.

On the other hand the 34 "good" farmers of the high expense group worked only 30 crop acres each, but they employed labor by the year and purchased enough extra feed to keep 31 animal units each, which gave profitable employment for their hired help during the winter months. Their net result after paying for this extra labor and feed, was a labor income of $2,221.

Of course, the quality of live stock is a great factor in determining whether or not extra expense for feed and labor is profitable. The 29 "poor" farmers of the high expense group paid out nearly the same amount for these items as did the "good" (and they kept only twenty-five animal units per farm instead of thirty-one), but their live stock still yielded them two per cent. less than the district average. On comparing the "poor" farms of the five groups it is seen that low medium or a little below average, is the best rate of expenditure. Either very low or very high expenditure results in low labor income. Poor quality of live stock on these farms was undoubtedly the cause of decreased profits with either a very low or a very high expenditure for feed and labor. They were not naturally productive, and hence when fed lightly went down to 79 per cent. of average. When fed heavily, they were brought up to within two per cent. of average, but the extra feed and labor required to do this proved a very poor investment. The man who has poor stock, but yet must do the best with what he has, will find it most profitable to be just a little sparing with feed and labor, and to spend more of his energy on other branches of the business.

The above conclusions are sustained by a similar analysis given below of Dundas County Farms for the year 1917.

Current Expenses	Farm Efficiency	No. of Farms	Live Stock Index	Labor Hired	Feed Bought Per Farm	Animal Units Per Farm	Crop Acres Per Man	Labor Income
Low	Good	30	98	$111	$111	19.1	42	$1166
	Poor	27	76	139	117	15.7	38	416
Low Medium	Good	31	105	313	258	22.6	32	1392
	Poor	36	83	361	286	21.8	31	434
Average	Good	22	113	344	318	23.9	28	1446
	Poor	27	93	459	322	24.7	31	524
High Medium	Good	17	117	456	538	27.5	29	1501
	Poor	18	93	477	563	25.9	29	461
High	Good	25	133	517	878	27.1	[illegible]	1546
	Poor	28	104	481	798	24.0	25	280

ECONOMY IN FARM EXPENSES.

From a study of the above table, it may be said that the farm organization determines whether or not strict economy in farm expenses is profitable. The "good" farms (that is the well organized farms) show a steady advance in labor income, with an advance in expenditure for labor and feed. (Labor and feed are the chief items of expense on the dairy farm). These farms are organized to profitably utilize the labor throughout the entire year and the live stock on these farms is of such a quality that the increase in feed and care meets with a profitable response. On the other hand, the "poor" farms show greatest profits where the expenses are the average of the district. Either raising or lowering the expenditure for labor and feed results in lowering the labor income. It will be observed that in all cases except that of high expenses, the live stock returns were below the average. In this one case so much feed and care were required to raise the stock returns that the result was even worse than in the first group where the stock were neglected to the extent that the returns were only 76% of the average. Poor cows will respond in a certain degree to good feeding and care—but their powers are limited. The dairyman must, therefore, regulate his expenses according to the producing capacity of his cows.

Another feature of the farm business brought out by this table is that the labor income can be kept up by extreme hard work on the part of the operator. The operators of "good" farms of the low expense group kept up their labor income by working 42 crop acres each. Their labor charge of only $111 indicates that they employed labor only during the harvest. With practically no help also, these men cared for an average of 19.1 units of live stock, which they maintained in such a manner that they yielded only two per cent. below average. But the next lower group, by employing more labor and buying slightly more concentrated feeds for their cows increased their average labor income by $226, while each man worked 32 crop acres. As was stated previously the extent to which this increase in farm expenses can be carried profitably, is determined by the quality of the dairy herd—as a comparison of the "good" and "poor" farms in various groups clearly shows. It is understood that in many instances, during 1917, the farmer had to do all his own work because farm labor could not be procured, but these figures disprove the theory, advanced by some, that the only road to success in farming is in keeping expenses down to minimum. It must be concluded therefore, that a proper balance must be obtained between these three great factors influencing the profits. Neither good crops, good live stock nor niggardly economy can alone make success. They must go hand in hand. But the most important appears to be the quality of live stock, the milk yield of the cow. Without this being large the other two factors will not prevent failure.

CHAPTER XV

DAIRY FARM ORGANIZATION

INTENSITY — SPECIALIZATION — WINTER FEEDING

PREVIOUS chapters have dealt with the great influence on farm profits exerted by the size of farm and in this connection it has been pointed out that with any average or moderately-sized dairy farm, good farm methods, live stock and equipment may be of more importance in providing a suitable net income than is size of the farm. At any rate these factors offer opportunities, not always grasped, to increase largely the farm returns without the addition of more acres, though it must be admitted that the larger farm will invariably add to the farm profit without any change in method and organization.

The previous chapter has likewise pointed out the influence of the physical factors, crops and live stock, their yield and quality, on the success of the year's business, and has pointed to a necessity of the proper co-ordination between these factors and the human elements of economy and thrift to accomplish a happy end financially of the year's effort.

INTENSITY

One of the most apparent features of the proper co-ordination of crops and live stock is the intensity of the development of these two factors on a farm of given acreage. In other words the operator of this farm might ask the question: "How much labor of man, horse and equipment and how much live stock can I profitably devote to my farm in its present condition?" This is to-day a question most difficult to answer. Many observers of farm conditions the world over, have submitted answers based on comparisons of produce or revenue per acre in good European agricultural disticts with similar production on Canadian farms. In this respect we do not compare very favorably with the European farmer. But basic conditions are entirely different in the two areas compared. The European countries have a large population on a small area of land. This means a plentitude of labor and a scarcity of land, low priced labor, and high priced land. We in this country have a limited population on an enormous area of farm land, this spells a scarcity of labor and a plenitude of land, high priced labor and low priced land. This fundamental difference in basic conditions requires us to accept with hesitation recommendations for organization of Canadian farms based on conditions in other lands. Our position of high-priced labor and low-priced land makes inevitable the possibility of devoting too much in the way of labor and other expense to a given acreage of land. Fortunately, however, our dairy farmers have not grievously sinned in this respect. On the contrary there is good ground for the belief that they have not, as a class, reached the point of enough intensity of operation, that they have spread their labor, effort and equipment over too much area. This is true in many cases and it is also true in many instances that our farmers have instinctively reached and followed the correct balance in this respect.

One method of increasing both the size of farm and intensity of operations is to make fit for cultivation all the useful and fertile land on the farm. As our country is yet in the infancy stage there are still found in all good dairy districts a few acres of good land on many farms that have not yet been brought under plow and produce nothing but indifferent pasture for a part of the early summer. Much of this land requires only drainage, or some stumping or brushing. This does not apply to the wood-lot or to any poor, light and stony land that would not be worth cultivating for crops.

In the survey by the Farm Management Department of the Guelph College, of Oxford County farms in 1917 a study was made of the economic possibilities of clearing up as much as possible of the good land in a dairying district. For this purpose the returns from 100-acre farms which had varying amounts of cleared land are set forth in the following table.

Tillable Area	No. of Farms	Average Tillable Area (acres)	Crop Area (acres)	Selling Value of farms.	Capital in Live Stock	Labor	Feed Bought	Total Current Expense	Labor Income
Under 71 acres	35	65	52	$8219	$2386	$318	$344	$1043	$ 666
71 to 80 acres....	34	76	60	9250	2765	306	358	1096	1116
81 to 90 acres....	37	85	68	9543	2614	347	348	1119	1252
91 to 100 acres...	28	93	67	9818	3088	355	426	1247	1408

It will be seen that more than one-quarter of the 100-acre farms in the survey had more than 30 acres of land per farm not fit for the plow. That some of this land could be put into cultivation to good advantage is demonstrated by the experience of the 34 farms which had from 70 to 80 acres of tillable land. Their farms averaged $1,031 higher in selling value, showing that from an investment standpoint alone, if such land could be cleared for $100 an acre or less, it is a good business proposition. From the labor income standpoint, the effect of more tillable land in the farm has a great influence. We see an increase of $450 in labor income from clearing up the first 11 acres. This additional tillable land gave an opportunity for keeping more live stock without adding much more expense in the way of labor, buildings, feed bought and other farm expenses, so that the extra income was nearly all profit.

There is not such a marked improvement either in selling value of farms or in labor income in the last two groups, but sufficient, however, to warrant putting as large a proportion as possible of the land under cultivation, especially in such well developed districts as Oxford. It is worthy of notice that the selling value of the last two groups of farms does not show any large increase over the second group. This leads to the belief that from 10 to 15 acres untilled land, if it is in good woods or good natural pasture, does not detract from the market value of the farm. It is well to observe, however, that the labor income increase on these two groups demonstrates the benefit of clearing up as much of the farm as possible. A return to normal labor conditions and normal prices for drainage operations in the near future will make this point one worthy of attention.

Another feature of dairy farming worthy of consideration is the amount of live stock, particularly cows, that can be kept profitably on a given area of land. The young man who is just commencing to farm, or even the older and established dairyman, should ask the question: "How many cows can I keep profitably on 100 acres"—or 50 or 150 acres, as the case may be. The following study of 305 Oxford County farms in 1918 will help to answer this question.

NUMBER OF ACRES PER MILCH COW FOR GREATEST PROFIT

Tillable Acres Per Milch Cow	No. of Farms	Labor Income	Milk Sales Per Cow	Labor Hired Per Farm	Feed Bought Per Farm
4 or less (Av. 3.8)	31	$1790	$116	$400	$313
4.1—5.0	72	1438	121	441	375
5.1—6.0	79	1413	114	386	249
6.1—7.0	63	1183	113	442	229
7.1—8.0	27	935	97	527	240
Over 8.0 (Av. 9.9)	33	780	97	287	127

On each of 305 farms, the number of acres in the "Tillable Area", was divided by the number of cows milked during the year. This gave the number of tillable acres per milch cow. On the 305 farms, the number of tillable acres per cow varied from less than three to more than fifteen. On the larger proportion, however, the variation was from four to seven. This figure represents acres per milch cow only. Young stock necessary to maintain the herd were not included in the calculation. The farms were then grouped, according to tillable acres per cow, into six groups, as shown in the table. A glance at the labor income column shows that the farmers of Oxford are not yet stocking too heavily for profit. The most heavily-stocked group of 31 farms made more than twice the average labor income made by the most lightly stocked group of 33. The other groups varied in labor income in direct accord with the rate of stocking. The quality of cows, as evidenced by the "Milk Sales Per Cow", column, did not vary greatly except in the last two groups. It was not surprising to find these two groups low in quality of cows; farmers who have as few cows as these are not usually good dairymen in any sense. As would be expected, the highly stocked farms were forced to buy more feed, but this extra expenditure was well repaid. Labor charges did not vary greatly except in the last group, in which they were low. It may be said, therefore, that an increased rate of stocking with milch cows will do much to increase the average farmer's labor income.

Specialization

Amongst many thoughtful dairy farmers the wisdom of devoting all the energy of the operator and the facilities of the farm to the dairy herd is open to question. The opinion of many men seems to indicate that for the average farmer some revenue ought to be derived from other sources besides the cow, such for instance, as hogs, sheep, poultry, colts and the growing of some crops for sale.

The following table shows the comparative results of the various methods pursued in Oxford County in 1917.

Per cent. of Farm Revenue from Dairy Cattle	No. of Farms	Labor Income	Labor Per Farm	Receipts Per Cow in Milk	Live Stock Index	Feed Bought Per Farm	Crops Sold Per Farm
Below 51%	35	$1066	$403	$ 68	94	$360	$366
51 to 60%	41	1174	410	88	98	375	246
61 to 70%	84	1258	373	95	100	365	179
71 to 80%	78	1174	346	108	100	381	211
81 to 90%	53	1175	383	116	102	390	134
91 to 100%	31	1006	374	124	102	404	41

The outstanding feature of this table is the decreased profits or labor incomes of those farmers who receive less than 50% of their revenue from dairying and of those who receive nearly all their incomes from the dairy. The largest profits are received by those receiving from 61 to 70% of their revenue from dairy cattle and the balance from other sources as sale of crops, hogs, sheep, poultry and horses and in some instances from the grazing and fattening of a few beef animals. They have larger profits in spite of the fact that their cows do not produce as much milk as the cows of those who are making an entire business of milk-production. They accomplish this by making use of the profits to be derived from other live stock and cash crops, which can, in many cases, be made use of without adding to the yearly cost of running the farm. For example, a flock of sheep or a few pigs can be raised without adding to labor hired or to buildings, and a cash crop will often make more profitable use of part of the land than can be made by growing crops for feeding cattle. These other sources of revenue just mentioned no doubt have a greater influence now than in normal years of prices for hogs, sheep, wheat, etc., but at the same time we must draw the definite conclusion that the average dairyman should not shut himself off from opportunities for making a few dollars here and there from other sources than the dairy cow.

It cannot be denied that these men who receive 61 to 70% of their revenue from the dairy could make larger returns and get full advantage from their good organization of business by increasing the quality of their cows so that they would produce as much as the cows of the farmers who specialize in dairying. Among the 84 farms which received 61 to 70% of their revenue from dairy production were 40 whose cows averaged $123 in milk per year. The comparison of their business with the group in the above table which had equally good cows follows:

	No. of Farms	Receipts Per Cow	Labor Income
Farms with good cows, receiving 61 to 70% of Revenue from dairy cattle	40	$123	$1487
All farms receiving 91 to 100% of revenue from dairy cattle	31	124	1006

The result is very obvious. More obvious is the necessity of the purely dairy farms giving attention to the opportunities of a more general business for greater profits and at the same time keeping up the quality of their cows.

The above conclusions are strongly substantiated by a study of the same farms in the following year. The table below presents in the same manner the results of various degrees of specialization on the same farms in 1918.

Percentage of Total Farm Receipts from Dairy Herd	No. of Farms	Labor Income	Milk Sold Per Cow	Labor Hired Per Farm	Feed Bought Per Farm
Below 51%	43	$ 861	$ 79	$408	$217
51 to 60%	55	1384	99	445	269
61 to 70%	65	1485	108	465	274
71 to 80%	79	1285	117	394	276
81 to 90%	47	1335	124	442	233
91 to 100%	38	986	134	409	304

The first group of forty-three farms received less than half of their gross income from the dairy herd (including both the milk sales and sales of young stock). The operators of these farms might be classed as "mixed farmers" rather than "dairymen". The second group of forty-five farms received 51 to 60% of their gross income from the dairy herd. The degree of specialization increases throughout the table, until the last group is composed of thirty-eight farms which sold practically nothing but milk and dairy live stock—dairy specialists in the strictest sense. A glance down the "Labor Income" column shows that the best results were obtained by those men who received between 60 and 70 per cent. of their income from their dairy cattle and between 30 and 40 per cent. from cash crops, hogs, colts and poultry. In other words, they were dairymen carrying profitable side lines, or it might be said that they were "two-thirds dairymen and one-third mixed farmers". However, the variation in labor income, in the four centre groups of the table, is so small that no absolutely definite degree of specialization can be set down as being the most profitable. The extent of specialization most profitable will depend largely upon the location of the farm, its distance from the milk market and the nature of that market. The man who sells milk to a cheese factory and gets his daily supply of whey can certainly raise more hogs and raise them more cheaply than can the man who sells whole milk. A farmer whose land is particularly adapted to the growing of some cash crops (such as wheat, clover seed, or sugar beets), and who is close to a shipping point, may find it profitable to grow a limited acreage of this crop and buy a little more feed for his cows. The individual ability of the farmer himself must be considered. Some men cannot get high yields from dairy cows as profitably as others, and high yields are essential to profitable specialization. But the above table does show two things conclusively: first, that the average man must receive at least half of his gross income from the dairy herd, and second, that he must not go to the other extreme and neglect all side lines. The group of "strict specialists" made almost as low an average labor income as did the group of "mixed farmers". And in consideration of the fact that the 61 to 70 per cent. specialization group made $150 more labor income than any other group of higher specialization, it may be said that this is the safest and best organization for the *average* man.

In the preceding paragraph attention is called to the influence of the market to which the milk is sold on the degree of specialization. It is quite obvious that a market which pays a larg[illegible]ice for milk would tend to encourage more specialization in milk production because the added profits from milk on account of the higher price would overshadow the profits that side lines provide in the final summary of the year's farm business. Conversely a low-priced market would reduce the profits from milk production further below those received from the suitable side lines and would tend to lower the degree of specialization in milk that would be profitable. This feature of the business was given some study in the Dundas County Surveys of 1917 and 1918. In this County were found the lowest and the highest markets for milk in those ye[illegible]s in Eastern Canada; the cheese factory, a low market on account of Government regulation of the price of cheese, and the Montreal whole milk trade, the highest market in Eastern Canada; and a condensory which paid Montreal prices in order to get patrons. In an endeavour to find out the extent to which specialization was profitable in each of these two classes of markets in 1917, the Dundas County farms were divided into two groups which are shown on the table below:

A.—CHEESE FACTORY PATRONS

Percentage Receipts from Dairy Herd	No. of Farms	Labor Income	Labor Per Farm	Receipts Per Cow (Milk)	Feed Bought	Crops Sold Per Farm
Below 51%	18	$1067	$465	$70	$464	$366
51 to 60%	40	931	396	80	446	202
61 to 70%	62	904	347	81	284	148
71 to 80%	46	741	338	93	317	123
81 to 90%	15	560	356	93	356	62

B.—CONDENSER PATRONS AND MILK SHIPPERS

Percentage Receipts from Dairy Herd	No. of Farms	Labor Income	Labor Per Farm	Receipts Per Cow (Milk)	Feed Bought	Crops Sold Per Farm
Below 71%	16	$ 949	$460	$ 96	$500	$291
71 to 80%	29	841	376	105	580	155
81 to 90%	21	1238	421	139	418	151
91 to 100%	18	1175	579	159	478	65

The first casual glance at these tables shows the tendency to specialize produced by the market catered to. Table B shows only 16 farms out of

84 receiving less than 71% of their farm revenue from the dairy herd, while Table A shows 120 farms out of 181 utilizing sources other than the dairy herd for 30% or more of their gross revenue. Those men who specialized to a greater degree than 70%, and sold to cheese factories, did so at a very material loss. The selling of some cash crops and the feeding of other live stock, particularly hogs, was more profitable than high specialization in milk production.

On the other hand those who sold to condensers and the Montreal market found it profitable to specialize up to 90%, as is indicated by Table B. These men received for their milk an average of 55 cents per hundred pounds more than the cheese factory patrons. This fact tended to equalize the comparative profits from milk and from other sources of revenue and enabled a greater degree of specialization in milk production. But those who neglected all other sources of income suffered by so doing. Even where cows are of high quality and the price for milk is good, the dairyman cannot afford to neglect all side lines. As in any other manufacturing business, the side lines or by-products, if judiciously handled, help to reduce the cost of the main article of the business—with a corresponding increase in profits.

The above finding was corroborated by the 1918 Survey on the same farms, the details of which appear in the following table.

Per cent. of Revenue from Dairy Herd	Cheese Factory Patrons			Milk Shippers and Condenser Patrons		
	No. of Farms	Milk Sold Per Cow	Labor Income	No. of Farms	Milk Sold Per Cow	Labor Income
Below 51%	31	$65	$848			
51 to 60%	46	72	938			
61 to 70%	41	81	744	24	$ 96	$ 888
71 to 80%	30	90	731	34	114	1040
81 to 90%	12	79	363	53	130	1075
91 to 100%	0	0	0	19	129	684

In the above table we find the same characteristic division of the proper degree of specialization according to the market supplied as was found in the previous table. The cheese factory patron who received 50% to 60% of his revenue from his milk enterprise made the highest profits, though his cows were not as productive as those of the farmers who specialized to a greater extent, while the condenser and city milk trade, a market about 50 cents per hundred pounds higher than the cheese factory justified specialization up to 80% to 90% of the farm business.

In connection with this discussion on specialization it is well to point out also that the above tables and comment are based on the average farm. It is well known to all dairymen that there are some men who are making most satisfactory profits from even extreme specialization in milk production. Among the 400 Oxford farms surveyed in 1917 were found some farmers who made a specialty of high-producing cows, in most cases, pure-bred cattle, and very high class grades. There were about 20 farmers in this class. The results of their year's work were as follows:

No. of Farms	Per cent. of Revenue from Dairy Cattle	Labor	Receipts per cow	Feed Bought	Crops Sold	Labor Income
20	88	$395	$160	$512	$194	$2007

These farmers had labor incomes much greater than any of the average groups in the preceding tables. They were, by experience and inclination entirely fitted for specializing in a highly perfected dairy business. But they were so few in number that we are forced to the conclusion that the great majority of the dairymen, even in Oxford, are not yet ready for extreme specialization until they acquire the experience and quality of cattle necessary for such methods. Even these 20 high class dairy farmers realize the advantage of some other sources of revenue besides the dairy cow as they sold nearly $200 in crops per farm and from this and other sources received an average of 12% of their incomes. They represent the perfection of method to which all dairy farmers might strive.

The dairyman must decide for himself, therefore, whether his own natural ability will allow him to enter the realm of the specialist, with its opportunities and at the same time its hazards, or whether he is better off on the surer footing of average ground, where his chances of great success are fewer, but where he is sure of being at least fairly comfortable.

On a previous page of the chapter in which the question of intensity of operation was discussed, it was pointed out that increased farm profits resulted from keeping as many cows as possible on a given acreage. This would appear to conflict with the suggestions just made that specialization in milk production should not be carried by the average farmer to too high a degree. It appears, however, that increasing the number of cows on a farm does not necessarily mean that side lines be reduced. The following table of highly stocked farms in Oxford in 1918 shows that increased intensity of dairying does not need to be accompanied by any great changes in the degree of specialization followed for greatest profit. In this table are the thirty-one farms which were shown on page 204 to have had a cow to each four acres or less of tillable land. These farms were the most highly stocked farms in the survey and also had the largest profits of any group based on rate of stocking. Fifteen of the thirty-one farms specialized to the extent of only 66 per cent. of their revenue from the dairy herd and had $287 more profits per farm than did the other sixteen farms which specialized to the extent of over 90 per cent. of their revenue from the dairy. The table following shows this clearly.

EFFECT OF TOO GREAT SPECIALIZATION ON 31 HIGHLY STOCKED FARMS

No. of Farms	Degree of Specialization	Labor Income
16	91%	$1647
15	66%	$1934

WINTER DAIRYING

All-year dairying, or winter dairying as it is more commonly called, has proven a most profitable feature of successful farm organization in Oxford County and other dairy sections. From exactly 300 farms in the Oxford County Survey of 1918, a detailed statement of monthly milk sales was obtained. This permitted of a separation of summer dairymen from those selling a large percentage of milk during the winter months. The following table gives the results of the year's operations on these different types of farms.

	No. of Farms	Labor Income	Milk Sold Per Cow	Feed Per Cow	Profit Over Feed
Summer Dairymen—					
Those selling more than 2/3 of year's milk in summer months—April 1 to September 30......	164	$1111	$101	$77	$24
Winter Dairymen—					
Those selling more than 1/3 but less than ½ of year's milk in winter months—October 1 to March 31	102	1385	121	85	36
Strictly Winter Dairymen—					
Those selling more than ½ of year's milk in winter months—October 1 to March 31........	34	1722	132	84	48

One hundred and sixty-four out of the 300 were found to sell more than 60 per cent., or two-thirds, of the year's supply of milk during the summer months — April, May, June, July, August and September. The other 136 sold more than 40 per cent or one-third, of the year's milk during the winter months — October, November, December, January, February and March—and hence may be classed as " winter dairymen." For the purpose of further comparison, the winter dairymen were divided into two groups. Thirty-four out of 136 sold more than half of the year's milk during the winter months, so they were grouped by themselves and termed "Strictly Winter Dairymen". A glance at the table shows a steady increase in labor income with the increase in proportion of milk sold during the winter. More feed per cow is required to produce winter milk, but the price received more than makes up for this extra cost of production. There is also another factor which has an important bearing on winter dairying. The cow which freshens in the fall is in the natural flush of milk during the winter months. In the spring, the stimulus of fresh grass keeps up a strong flow of milk, with the result that this cow gives more milk during the year than does the cow which freshens in the spring. In the latter case the cow is nearing the end of her lactation period when winter feeding commences, and it is both difficult and costly to keep up her milk flow under these combined disadvantages. The profits from winter dairying are due largely however, to a better use of the feed and labor of the farm during the winter. This condition may be stated roughly as follows: Presuming that it costs $45 a winter for feed and labor to carry a dry cow over winter, (the other costs, buildings, equipment, depreciation and interest not being increased any by winter dairying), and that an additional $25 in feed and labor will cause that cow to return $40 worth of milk, it is plain that she has not repaid the $70 total cost of feed and labor; but the net cost of wintering that cow was only $70 less $40 milk returns, or $30 as compared with $45 if she had not been milked. In addition to $15 per cow saved in wintering, productive labor was provided for the farm labor during the winter which would not have happened if no winter milking was done. Since, therefore, cows have to be wintered anyway at a large cost, it is well that no dairymen overlook the opportunity for cutting down wintering costs by a development of winter dairying.

CHAPTER XVI

ECONOMICS OF BREEDING AND FEEDING

MUCH of this book has been devoted to methods of feeding, care and management of dairy cows. Much stress in other chapters has been put on the absolute necessity of high producing cows in a successful farm business. As high production of milk can come only when the feed fed is correct in volume and in kind, it is worth knowing the extent to which the efficient use of this feed is due to the feeder's skill and how much to the inherent ability of the cow to make profitable use of feeds.

Although the best feeding methods are not by any means found on all dairy farms it is the writer's firm conviction that the general average of skill and knowledge on the part of the feeder is much higher than is the general average of the cow's ability to make good use of feed. It is his conviction also that the low average production of our dairy cows is due more to poor breeding methods than to poor feeding methods although the latter contributes a large share of the failure in the dairy herd. It appears reasonable to suppose that if a cow lacks the ability to efficiently make milk out of food that no amount of skill in feeding will make her a more efficient machine, while it must be recognized that nearly all dairymen in this country realize that a cow cannot milk without a fair volume of food, and even if they use only the farm grown feeds without concentrates purchased to balance them, the errors in feeding cannot be serious enough to account for low returns.

Interesting and illuminating data on the comparative influence of breeding and feeding were discovered in the surveys of dairy districts of Oxford and Dundas Counties by the Ontario Agricultural College. The following tables show the general effect, not only on farm profits but on efficient use of feed, of the use of pure-bred dairy sires over a term of years in Oxford County.

INFLUENCE OF USE OF PURE BRED DAIRY SIRES ON PROFITS OF OXFORD COUNTY FARMS IN 1918.

Farms Using	No. of Farms	Labor Income	Milk Sold Per Cow	Feed Per Cow	Profit Over Feed Per Cow
Grade Sire or Scrub Sire only	131	$ 961	$ 94	$76	$18
Pure-Bred Sire, 5 years or less	49	1248	117	81	36
Pure-Bred Sire, 5 to 10 years	46	1473	115	81	34
Pure-Bred Sire, over 10 years	74	1710	137	86	51

This table needs little explanation. Feeding methods and amounts of feed did not vary more than 12 per cent. between the highest and lowest groups yet the increase in returns for feed was nearly 50 per cent. greater in the group of best breeding while the actual profit per cow over cost of feed was increased 300 per cent. as a result of continuous use of pure-bred dairy bulls for more than 10 years. It is doubtful if the highest feeding skill in the world could bring the cows in the poorly bred group up to the state of efficiency reached by the average cow in the best bred group.

These conclusions are more graphically brought out in the following table prepared from 139 of the farms in the above group. These farms were those in the Oxford Survey of 1918 from which sufficiently full data were procured to enable a calculation to be made in the cost of producing milk. The table demonstrates the comparative efficiency of breeding and feeding in affecting the cost of producing milk.

Farms with	**All-Grade Breeding or Pure-Bred Sire less than 5 years**	**Pure-Bred Sire more than 5 years**
Feeding Low——. (below $86 per cow)	**No. of farms.........45 Herd Average 4400 lbs. Cost per cwt.....$3.08**	**No. of farms ....31 Herd Average 5400 lbs. Cost per Cwt. $2.03**
Feeding High .... (above $86 per cow)	**No. of Farms ......30 Herd Average 5400 lbs. Cost per cwt. ...$3.00**	**No. of farms ....33 Herd Average ..6100 lbs. Cost per Cwt. $2.28**

The above shows that both methods of increasing herd production are employed by the Oxford County dairymen. The upper left hand group were both poor feeders and poor breeders; consequently, their herd average was only 4,400 pounds per cow, and their average cost of production was

$3.08. The lower left hand group were poor breeders but liberal feeders. By feeding alone, they raised their herd average to 5,400 pounds per cow, at an average cost of $3 per cwt. The upper right hand group used the other method to increase milk yield. They were sparing feeders but each man had used a pure-bred sire to head his herd for over five years. In consequence, their herd average was also 5,400 pounds per cow, but their cost of production was only $2.03 per cwt. The breeding method is slower in bringing results, but it can be carried on in conjunction with the feeding method, and a comparison of the last two mentioned groups shows its distinct advantage.

On going still further and looking at the lower right hand group, which is composed of farmers who are good breeders and at the same time liberal feeders, it is seen that the herd average has been raised to 6,100 pounds per cow, but the cost per hundredweight has also been raised twenty-five cents over the group above, due to the fact that the feeders' liberality overshadowed their knowledge of feeding principles, though this cost, $2.28 per cwt., is far below both groups with poorer breeding.

It is now, fortunately, becoming more generally recognized that, while better feeding is an essential part of the structure better breeding is the foundation of successful dairying.

Chapter XVII

CROP ROTATIONS — MAINTENANCE OF FERTILITY

SOUND farming practice demands that the crops on each field be changed from time to time. This is commonly called Rotation of Crops. To some extent rotation is practised on practically all Canadian farms, especially in the older districts. In the new West where fertile soil, sparse population, and transportation and social disadvantages prevail, the farm lands are largely devoted to the growing of wheat and other cereals with the occasional inclusion of a summer fallow.

In all dairy districts, however, East or West, the introduction of the live stock element has forced upon the farmer the necessity of a greater variety of crops, and therefore, rotation of crops is practised instinctively if not deliberately. Even if the added live stock factor would not in itself force rotation, the weed, insect and plant pests would determine that each field grow a variety of crops in the course of a few years. In all good farming practice, crop rotation has the following beneficial effects: (1) Control of weed, insect and plant disease pests, (2) Maintenance of the humus supply of the soil, (3) Growth of some crop each year, (4) Balanced removal of the different kinds of plant food, (5) Improvement of the texture of the soil from an alternation of deep and shallow rooted crops. In dairy farm practice crop rotation should, in addition, take into consideration the following factors:

(1) The saving of labor.
(2) The supply of sufficient roughage for the live stock.
(3) The supply of sufficient abundant pasture during the middle summer.
(4) A cash crop suited to the locality.
(5) As much farm grown concentrates as the above factors will permit.

It is not the purpose of this work to discuss in detail the advantages of crop rotation in general farming practice. These have been pointed out above and are quite generally recognized in the farming community. Rather is it the purpose of this book to deal with the subject of crop rotation on dairy farms in its connection with the dairy methods and dairy farm organization outlined in previous chapters.

As has been pointed out many times, the necessity of economizing labor on dairy farms is a most important factor. Crop rotation assists in this respect by enabling the farmer to grow a series of crops whose seed time and harvest may be spread out over the season without producing a serious labor crisis at a certain period such as invariably occurs where most of the land is devoted to one crop. In this connection it is interesting to point out that this labor question actually prevents the growing of an almost complete balanced ration on dairy farms. It is recognized that a full supply of alfalfa hay and corn silage will in itself provide milk not only economically, but in large volume, also that these two crops largely fulfill all the requirements of a crop rotation in respect to soil texture and fertility. But if dairy farms, individually or generally, were devoted only to this rotation the labor of the farm, both man and horse, would be thrown out of balance so badly that all saving in feed and fertility would be lost in acute difficulties of getting crops seeded, cultivated and harvested without undue waste, because the important operations of corn cultivating and harvesting would conflict seriously with alfalfa harvesting; labor, man and horse, could not be got for those conflicting operations and serious wastage of one or both crops would ensue.

Our present labor situation demands that the dairy farm work be largely accomplished by the farm family and limited extra labor, therefore, one of the first considerations of a good cropping system is a spread or variety of crops in which the important operations do not seriously conflict.

In this connection it is interesting to view the posibility of growing a large acreage of roots on a dairy farm. It is admitted that roots are an extremely valuable food as part of the ration of [illegible] animals of all ages. However this crop requires at times a large amount of hand labor not necessarily very skilled. On farms where there is little or no milking to do, the farm family often supplies this labor. On dairy farms at such times the family labor is absolutely essential for the twice daily milking. Therefore the dairy farmer must often forego the advantages of roots in favor of the corn silage crop which yields equal or greater dry matter per acre with a minimum amount of hand labor.

That the farm should supply the most of the roughage required by the herd is well recognized and that this roughage should be of good quality goes without saying. In the discussion of farm feeds in a previous chapter emphasis was placed on the importance of corn silage as a basis of profitable milk production. Attention also was drawn to the economic value of the clovers as a dry fodder. These two kinds of feeds are too bulky to permit of cheap transportation and in case of silage, transportation is entirely out of the question. Therefore, sound economy demands that they be largely home grown, that a large part of the dairy farm be devoted to their production. As pointed out just above only some farmers especially favored by family labor or a cheap source of hired labor can afford to grow roots as a successful roughage to largely supplant corn. In the dairy districts of the west, north, or maritime provinces the arguments in favor of corn silage in a crop rotation have equal force in respect to other silage crops such as sunflowers, or oats, peas and vetches.

Regarding the place of grain crops in a rotation of dairy farm crops it must be pointed out that certain acreage must be devoted to producing them. In the first instance, clovers can not be economically seeded except on grain crops and secondly, being shallow rooted they are a physical necessity in a rotation and last but not least they serve as cash crops of great value in many cases particularly wheat, rye and peas. It must not be forgotten, however, that the grain acreage should not be so large as to prohibit either the production of sufficient roughage, or the growing of a suitable cash crop of some other kind. Even though the farm-grown grain be ample, it is not, in itself, a feed of suitable quality to provide balanced rations with our common roughage. The net result would be either wasteful feeding results, purchase of roughages at too high a price, or a cutting down of the degree of specialization by not keeping enough cows for the size of the farm. It is well to emphasize that farm-grown grains can usually be bought at a price much nearer cost

of production than can any of our farm-grow
roughages because transportation of the form
is much cheaper, and that other dairy feeding co
centrates, bran, oil cake, gluten feed, etc., a
often the most profitable to purchase to make u
any deficiency in the necessary volume of co
centrates.

In dealing with the question of diversity
dairy farm business, attention has been drawn t
the possibility of a cash crop enlarging the far
revenues. In nearly all Canadian farm district
there are found one or more crops that give la
ger yields through soil or climatic conditions, o
that have a higher value through favourable ma
ket conditions, than these same crops have in othe
sections of the country. A few notable instance
of this fact may be found in the potato growin
districts of New Brunswick and some counties i
Ontario, the corn district in southwestern Ontari
the apple districts of Nova Scotia, Ontario an
British Columbia; the wheat in the Canadia
West and the good hay markets in all large citie
Every farm in a district that has a particula
money crop should produce some of that crop fo
sale. Land devoted to that crop yields a muc
larger return than if devoted to the growing o
some crop for feed, and even if it is not desire
to cut down the number of live stock kept in orde
to grow this cash crop, there is no better way o
raising the money to buy additional feed such a

concentrates than by growing the characteristic money crop of the district. Two purposes are served, the land grows its best economic crop and opportunity is afforded of buying the most suitable feeds for producing milk.

The question of the supply of pasture has been fully dealt with in a previous chapter and merits repetition only to emphasize the importance of including in a crop rotation some form of supplemental pasture that makes possible the continuance of good grazing in the hot summer months with its accompaniment of labor conservation in the rush season.

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